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REGENERATION, DEVELOPMENT AND GENOTYPE[1]

By Professor CHARLES E. ALLEN

UNIVERSITY OF WISCONSIN

THE potentialities of a many-celled plant or animal were derived through the single cell from which the development of the organism can be traced. It follows that the genotype of such an organism is the genotype of its originating cell.

This statement is wholly true, to be sure, only if during the course of development the original genotype has not been modified. Environmental influences can induce changes in chromosome number, in chromosome constitution or in genes, and hence modifications of the genotype of the affected cells. The commonest visible type of such change in plants is a doubling of the chromosome number in some or many cells. Tetraploidy, resulting from a doubling of the typical diploid number, is of common occurrence. Ordinarily the "spontaneous" appearance of tetraploid cells must be assumed to result from an unrecognized stimulus. But in some species, including hemp, melons and a number of Chenopodiaceae, tetraploidy and octoploidy are regularly characteristic of certain regions. Here the change seems pretty clearly not to result from external stimuli. It is in a real sense itself an expression of the plant's genotype.

The extent to which a doubling of the chromosome number constitutes a genotypic modification can for the present be tested only by the examination of deliberately induced polyploids. From these it appears that the distinguishing characters of a tetra-

[1] Abridged version of a paper presented at the Fiftieth Anniversary Celebration of the University of Chicago, September 22, 1941.

ploid offspring are essentially quantitative—changes, usually increases, in size of cells and resultant changes in size of organs and of the plant as a whole. But such quantitative modifications sometimes lead to changes in appearance which are easily interpretable as qualitative. For example, cells of *Oenothera gigas* are proportionally more greatly increased in length than in breadth as compared with those of the parent *O. Lamarckiana*. In consequence, the forms of organs, including leaves, are modified; the leaves are more crinkly than those of the parent form. Straub finds that similar quantitative modifications due to polyploidy lead in Antirrhinum, Torenia and Impatiens to conspicuous changes in shape and orientation of floral parts and in the distribution of floral pigments; and in Lupinus to a marked pubescence of leaves and stems.

In what follows, all effects of mutation, even though of limited extent, are to be excluded; solely to be considered is development based upon the original genotypic capital.

While it is rare that two individuals possess precisely similar genotypes, strains do exist whose members are genetically so similar that for practical purposes they may be considered together. The genotype of such a strain—*e.g.*, a clone—is naturally thought of first as expressed by the "normal" character of its members—the complex of qualities displayed under usual conditions. But these qualities are consequences of the interaction between genotype and environment; and the character of another member of the strain subjected to another set of conditions may be very different. The "normal" character of an organism, then, is but a partial expression of the range of possibilities represented by its genotype. How partial that expression may be, only extended experiment can determine. In order to know the full extent of a plant's genotype, that plant, or individuals genetically like it, must be exposed to every possible non-lethal combination of conditions. While the complete test remains only theoretically desirable, much of the information suggested by it is available from two sources.

First, with respect to the expression of particular genes or gene-combinations, genetic experiment shows that conspicuous phenotypic differences occur under diverse conditions.

Second, knowledge of genotypic possibilities is supplied by physiological experiment. In such work, it is true, care has not usually been taken to insure that the members of a species subjected to varied conditions are thoroughly comparable genetically. Hence the conclusions are to be accepted with qualifications. But, making all possible allowances, the general nature of the results demonstrates that differences in all the conspicuous characters of a plant follow upon differences in a variety of environmental co ditions. Interesting light upon genotypic possibili is thrown when certain stimuli induce the occurre of growths classed as nodules, intumescences or gal The remarkable form and structure of some in galls especially manifest potentialities inherent in plant but not expressed under usual conditions.

Evidently the genotype of any cell which can gi rise to a plant includes a wide range of developme possibilities; the plant's so-called normal charac expresses only a small fraction of its inherent capa ties; and, apart from mutation, any deviation fr this character is in no real sense abnormal; it is most unusual.

A distinct problem is that of the genotype of ea of the tissue ("somatic") cells which constitute plant—all derived through division from the origin ing cell. The Weismannian conception that quali tive nuclear divisions during ontogeny result in progressive simplification of the nuclear content somatic cells has of course long been untenab Despite the regular occurrence of chromatin-dimin tion at certain stages in certain animals, and despi possible mitotic disturbances in any organism by e ternal influences, an outstanding fact in both pla and animal ontogeny is the regular transmission each cell of a chromosomal complement exactly li that which characterized the originating cell. If t genotype of any cell of a later generation is less co prehensive than that of the originating cell, t explanation is not to be found in a modified nucle constitution.

The genotype of any of the cells of varied structu which constitute a plant is conceivably to be dete mined, as is that of the originating cell, by an exam nation of the variety of cells, tissues and organ which, under most varied conditions, can arise fr the cell in question. But since any such determinati depends upon the cell's ability to divide, it is necessa first to consider how wide-spread among plant ce this ability may be.

In filamentous algae and fungi, any cell, at leas while young, can divide. Essentially the same is tr in the gametophytes of the simpler hepatics, such a Sphaerocarpos or Riccardia. In more massive plan with differentiated tissues, the condition is less simpl Here each cell begins its life as an element of meristem. While the meristems of a plant—distin regions of root or stem apex, the cambium, and so on—differ somewhat one from another, all are characte ized by the possibility of repeated cell division.

Some meristems, like those of stem and root apice persist throughout the life of the organs of whic they are a part. Other distinct and more or le differentiated regions sooner or later display a mer stematic character. Among them are layers of corte

and phloem which may in time function as phellogen; and the pericycle of stem or root in which primordia of adventive roots commonly arise. Many other regions may become meristematic under the influence of appropriate stimuli.

While all cells originate as elements of a group which is marked by the capacity of its cells to divide, it is conceivable that in such a group cells might be formed which, destined to become differentiated, can not themselves divide. However, so many cells in so many regions do divide under ordinary or special conditions, as for instance in consequence of wounding, that it can hardly be doubted that every plant cell at the beginning of its existence and for some time thereafter is able to divide.

Obviously this power may be lost with the onset of senility. Structural difficulties, such as the development of thick walls, may hinder or inhibit division. Cells whose walls have been markedly thickened ordinarily do not divide in response to a stimulus such as that of a wound. Not a few instances are reported, however, in which such cells, becoming dedifferentiated through the loss of their secondary wall layers and through other changes, proceed to divide. They return to a meristematic condition. Hence it seems that the power of division, inherent in each cell, may long persist.

Granting this generally present capability, what is the range of the structures whose development can result from the division of a given cell? In such plants as the filamentous algae and fungi and some of the simpler hepatics, whose cells remain substantially undifferentiated, it seems to be true that from any cell a complete new plant may arise.

The possibilities are less obvious in more massive individuals, such as gametophytes of mosses and sporophytes of vascular plants. In these, it has been seen that every cell, however highly differentiated it is destined to become, begins its existence in the meristematic condition. In mosses particularly, very many of the cells of the gametophyte evidently remain throughout their active life capable of developing into new plants. The capacity is manifested by the production in many species, on the most diverse parts of the plant, of vegetative reproductive structures. Since some of the structures classed with gemmae are of the nature of abscissed leaves, branches or branch tips, this type of reproduction overlaps with the likewise wide-spread occurrence of proliferation from various organs. Such proliferation in most cases begins with the outgrowth of a cell into a protonema —a stage preliminary to the production of leafy shoots. Sometimes the first outgrowth is a rhizoid; but since rhizoids and protonemata intergrade and since either type of filament readily gives rise to the other, the distinction is not for present purposes important.

In some mosses, proliferation from parts not specifically set apart as reproductive structures occurs without apparent external stimulation; the stem bears a dense felt of rhizoids capable of developing protonemata and these in turn of producing leafy shoots. But more generally rhizoids or protonemata are put forth in response to stimuli such as those of wounds; sometimes in response to drying or to the aging or death of neighboring parts. Under these conditions, protonemata grow from leaves, from fragments of stem, branches or leaves, even from isolated sex organs or paraphyses.

As Correns has pointed out, proliferation occurs not from all the cells of a particular organ. Often the new development begins only in certain initials, which may be recognizable in advance. In the case of an organ of some thickness, as a stem, these initials are superficial. In a few species, proliferation occurs from an interior region exposed by cutting, but here also only from the thin-walled cells of certain tissues. Remembering, too, that in some mosses, notably species of Sphagnum, proliferation has not been induced by any means tried, it is clear that the broad statement sometimes made that *any* cell of a moss gametophyte is capable of this type of regeneration is not proved. On the other hand, the proliferation of particular cells often seems to be prevented by mechanical hindrances such as thickened walls. While, therefore, it is not shown that every cell can give rise to a new plant, neither is the absence of such a possibility demonstrated. Doubtless further experiment will show this potentiality possessed by at least a wider range of cells.

In pteridophytes and seed plants, functional differences become more evident between types of meristems, as shown by the nature of the tissues to which, in usual course, they give rise. Apical meristems commonly consist of fairly distinct regions, each regularly giving rise to particular primary tissues or tissue complexes. True cambium produces secondary xylem and phloem; phellogen produces cork and phelloderm.

Often, on the other hand, whole new organs with all their component tissues develop, without apparent external stimulation, from a single meristematic region. When, for instance, lateral roots develop from the pericycle, the genotype of the pericyclic cells included all the tissue potentialities of a root. If, as in the horseradish, a lateral root or a cutting therefrom gives rise to a bud and ultimately to a new plant, the genotype of the originating pericyclic cells in the primary root included all the potentialities of the race.

Buds borne on a stem which upon separation give

rise to new plants are familiar. These buds, however, have arisen ordinarily from the apical meristem, and their formation as a rule involves each of the meristematic regions of the stem tip. In a different category belong adventive buds occurring commonly on stems, sometimes on roots as in the horseradish just cited, and resulting from a renewed meristematic activity of epidermal and cortical cells. New plants may develop, too, from buds formed on leaves. Hagemann lists 46 species belonging to 11 families whose leaves, still attached to the parent plant and uninjured, bear buds.

These are developments in the course of the regular life cycle. New organs may be produced also in consequence of many special causes. The causal factor is commonly a stimulus applied from without; sometimes it is the aging and death of neighboring cells or tissues, or the abscission of a leaf, bud or branch. An effective external stimulus is most frequently a wound or a development, hormonal or other, consequent upon wounding. The resultant proliferation may involve cells adjacent to, or at some distance from, the wound.

In an excised or otherwise wounded leaf, cells of all tissues beneath the wound, except, apparently, the thick-walled cells of the vascular bundles, may be stimulated to divide. In dicotyledons, a distinct phellogen often develops. Meristematic activity, continuing beneath the phellogen, produces a thickened callus. Differentiation of vascular and other tissues sometimes occurs within the callus. Adventive buds and roots may arise, as in *Crassula multicava,* from the epidermis near the wound. More frequently, buds come from superficial cell layers, roots from deeper-lying tissues. On excised scale leaves of Lilium, leaf and stem primordia arise from a secondary meristem produced by the division of subepidermal cells; root primordia from interior cells adjacent to a vascular bundle.

Wounded surfaces of stems, roots and immature fruits characteristically form calluses as do those of leaves. Stems commonly, roots much less frequently, produce new shoots from calluses. Roots may develop from internal tissues of the wounded organ; if this does not occur, they are formed sooner or later by the new shoot. On stem cuttings the new adventive buds and roots sometimes appear at a distance from the wound; or buds may appear in one region, roots in another. The particular tissues of the wounded organ whose cells are stimulated to divide vary greatly from species to species.

Similar in their causal relations to the proliferations just mentioned, but different in their development, are intumescences and galls. In certain interspecific Crepis and Nicotiana hybrids, tumorous growths occur spontaneously—perhaps in consequence of an interaction between protoplasmic substances derived from the respective parents. The more frequent forms of overgrowth result from the bites and egg-deposition of insects, from infection by bacteria or fungi or from chemical stimulation. The varied tissue types that appear in these growths, as well as the frequent production from them of adventive roots and, especially in those forming witches' brooms, of adventive shoots, indicate something of the range not only, as previously suggested, of the genotype of the cell which gave rise to the plant, but also of the genotypes of those tissue cells which produced the overgrowth.

Stimulated growth occurs also from apical meristems. Particularly suggestive are the results of the culture of excised roots or root tips of various dicotyledons. In the tomato, growth of the root and differentiation of primary tissues may continue indefinitely. Abundant branch roots are formed. But no interfascicular or cork cambium, and consequently no secondary tissues, are produced. No shoots appear. It is true that roots of the same species, while attached to the parent plant, form cambia and secondary tissues—that is, their apical meristems ultimately give rise to all the elements of a root system. But in these, as in the majority of species studied, it has not been possible to demonstrate that from a root meristem can come all the structures of a complete plant. That the limitation here suggested is not universal, however, is shown by the fact that the development of shoots from root cuttings is regular practice in the propagation of a fair number of plants.

A comparable condition holds as to the cells of leaves. Hagemann has summarized the behavior of isolated leaves of 1,204 species of gymnosperms, dicotyledons and monocotyledons. Those of 289 species regenerated both shoots and roots; those of 25 produced only shoots, which, however, in most instances themselves formed roots; leaves of 501 species produced only roots; and those of 389 formed no new structures whatever. Of 21 gymnosperms, the leaves of 6 produced roots only; the others gave only negative results.

From the available evidence, it is clear that, as has long been held, a large proportion of plant cells manifest, through the products of their division, the possession of a genotype equivalent to that of the race. But it is far from being demonstrated that all cells of all plants are in this sense totipotent. The opposite conception is suggested by the fact that, so far as experiment has shown, the cells of some tissues can give rise only to certain plant parts. Conspicuously, in the majority of angiosperms tested, leaves, roots and root meristems seem unable to regenerate complete plants. Doubtless the power of proliferation may by improved methods be shown to be more wide-

spread. But for the present it must be admitted that the comprehensiveness of genotype seems to vary as between the cells of different tissues, of different organs, and even more as between cells of corresponding tissues in different species.

This conclusion, if it becomes a conclusion, contradicts the expectation derived from the general uniformity of nuclear structure throughout the life of a plant. There would seem to remain as the only possible explanation of the apparent facts the occurrence of genetically effective cytoplasmic differences between the cells of different tissues or organs. Much evidence indicates that related species may differ significantly in cytoplasmic constitution, and that this constitution favors or inhibits the expression of particular genic potentialities. The cytoplasm of a cell, then, in some measure helps to determine its genotype. The possibility is suggested that in the course of ontogeny cytoplasmic differences may appear, one consequence being that, while the ability to divide persists, the genotypic capacity of the cells of particular regions is limited. In the absence of more positive evidence, this possibility remains for the present nothing more.

THE UNIVERSITY AND THE PRESENT CRISIS[1]

By Professor ANTON J. CARLSON

UNIVERSITY OF CHICAGO

You have assigned me a sobering subject. The present crisis is war, all-out war. I am talking to mature colleagues, men and women trained in weighing evidence. I have worked in the college and in the university for nearly fifty years. My service in the Army in war (A.E.F.) fortunately covers a much shorter period (1917–19). But after the Armistice in November, 1918, I saw more of the backwash of war in all the war-devastated countries of Europe than perhaps any other member of the A.E.F. So I should know something of both the university and war.

To me, education and war seem to be incompatibles. Education aims at approximate truths and understanding; it tries to develop free, inquiring, fair and just minds. Education is constructive: It tries to make two blades of grass grow where only one blade grew yesterday. The student worthy of that name asks "what," "why" and "show me the evidence." The soldier obeys. Obedience to laws and the command of others are important, but not the most important lessons for citizens in civil life. Individual responsibility, understanding and performance are of more profound and abiding significance for a healthy human society. War is destructive: "The scorched earth," destructive of human life and health; destructive of the fruits of human toil; destructive of the finest, the fairest and the most frail flowers of human social evolution: the search for understanding and the attainment and application of justice. War and hate are Siamese twins. Hate and fear do not create understanding, light and happiness.

The hysteria, the fear, the false propaganda, the hopes and the necessities of an all-out war, in the very nature of things, invade the university, the college campus. Yes, even the "little red schoolhouse" and the more pretentious high school. These forces and necessities affect boards of trustees, budgets, teachers, investigators and students, just as they affect every man and woman on the street, on the farm and in the factory. If this summary is even approximately correct, how are we of the colleges and the universities to meet these terrible issues?

In the first place, we, of all people, should endeavor to keep both feet on the ground, re-examine the moorings of education for democracy and men relatively free, and not do anything obviously wrong and foolish, such as: (1) Giving the bachelor degree at the end of two years in college. For such a measure can not remedy faults and failures in our system of education. We can not do that either by giving or withholding any degree at any stage of education. Such a proposal causes plenty of confusion, at least for a time, and evades the main issue: The fault's not so much in our educational system as in us, the teachers and the students. Are all of us real teachers, do all of us really teach, by precept and by example? And do our students really study, or do they play and loiter on the way? To be sure, the bachelor degree has not the same significance of achievement in all students even in the same college or university. And I admit that an exceptional student may achieve a mastery and a training in two college years that a few other students fail to attain in four years in college. But I do not think that this applies to the mine run of the American youth. If state laws permitted, some stupid medical school faculty might give the M.D. degree to the student after a sojourn of two years in the medical school classes, as was done in our country quite generally fifty or a hundred years ago. But such a measure now would not be a step in advance of medical education.

[1] Presented at the regional conference of the American Association of University Professors at Louisiana State University, March 6, 1942.

(2) We should not pretend that "general education" can be completed or is "completed" at the end of two years in college, on any plan; or that something significant, either for education or war, is achieved by the student or the college by giving any kind of label or degree to the student on this impossible achievement. We can, by various educational plans, subject students to a broader educational exposure during the high school, the freshman and sophomore years. Examinations will disclose the percentage of "takes" mainly in the matter of temporary memorizing. What will carry over in the line of understanding, motivation and achievement in the life of these students, no college faculty can guarantee. If I have any grasp of the meaning of "general education," that starts in infancy and continues throughout life, at least in the case of those men and women who are and who continue to be intellectually alert and intellectually omnivorous.

(3) War, and especially an all-out war, spells increased regimentation and autocratic dictation in many fields for the duration. There is not lacking signs that misplaced and myopic chairmen of college departments, deans, college and university presidents, as well as boards of trustees are being infected by this virulent virus of dictation, to the jeopardy and detriment of the essential individual freedom and responsibility, both of the members of the faculties and the students. We do not have to, we should not copy the dictators of other lands, in the field of education and fundamental research. If we do, we thereby administer a setback to college and university education in our country.

(4) The period of universal war hysteria and fear may be a time for re-examination of our educational moorings. But it is not the best period to inaugurate basic educational reconstruction. That work calls for mental calm. There is little or no evidence that human nature has undergone much change in the last hundred thousand years. Man in every land will be much the same at the end of this war. This seems to be the story of man. The Alexanders, the Caesars, the Genghis Khans, the Napoleons of the past killed and maimed people and destroyed the fruits of human toil. But they did not change man. I think the same will be true of this war. This war will make man poorer. It might be worth it, did it make him wiser. The processes of education found relatively effective yesterday will do the same work with similar youths to-morrow, if we aim at understanding and freedom, and not perpetual regimentation, violence and war.

The foregoing may be designated negative obligations on the university during the present crisis, something we should not do. There are equally important positive obligations on the university in this crisis, things that we can and must do. Among these are:

(1) A tightening of our intellectual belt, a greater attention to duty, both as teachers and students. This may mean more hours. It certainly means the old hours better spent. I have long sensed that we could dispense with the doll and the nursing bottle and advantageously add more iron to our intellectual loaf on many sectors of our educational front. This we can do now, instead of wasting our attention and time on curricula and degrees. That reminds me of Lessing's fable of the Raven and the Eagle: "The Raven saw that the Eagle sat upon her eggs for thirty days, and that from her offspring sprang the king of birds. I also, said the Raven, will sit upon my eggs thirty days, and my children shall rule the feathered kingdom. So the Raven sat upon her eggs for thirty days, but she brought forth only ravens." As applied to higher education, the obvious reply to Lessing's tale is this: we don't sit on any and all eggs. Deans and Committees on Admission select the eggs. Yes, yes, but look at some of the failures that are hatched after the four years of "sitting"—chicks that chirp, but won't scratch! If a student does not get exposed to "culture" and "general education" in every course in the college or university, that student is still in the cradle or the teacher should resign.

(2) Most universities and some colleges have laboratories, libraries and teachers needed for the training of men in the special services of our armed forces. These services and facilities should be, and I think are, at the full disposal of our government for the duration. In some cases, this may result in some inconvenience to regular undergraduate, as well as graduate students, as well as more work on the part of members of the faculty. But what of it? If special courses, if summer courses bring in additional funds to the university, it seems obvious that such funds should go to those who do the extra labor. If no extra funds materialize, we should still do this work, to the best of our ability.

(3) Most universities and many colleges have scientific men and specialists in other fields who are in position to aid our government in the solution of the numerous scientific and other problems forced on us by this war. This important war service should be, and I think is, being rendered by our universities.

(4) It would seem obvious that our colleges and universities, even during the present crisis, must continue to train the usual, if not an increased, quota of physicians, chemists and engineers each year. If this is to be done these institutions must receive the usual inflow of superior students for such training. In the case of medical students at least, this means men and women with excellent personal character, in addition to sound bodies and superior mental stuff. Such qualities are equally valuable and acceptable to our armed forces. But while the part of our armed

forces trained to kill Germans and Japanese is the spear-head of our war effort, medical and other technical services are equally essential in this organized effort. And adequate replacements of this personnel must be provided for. I think this is a special responsibility on the university in this crisis. In the case of students in or accepted by the medical schools, this is already provided for by giving such students tentative commissions in the Medical Corps of the Army or the Navy. But the able and bona-fide premedical student during his first two years in college may still be drafted. So, after a year or two, the medical schools may not have enough first-class medical students to train. That would be a catastrophe, and we must see to it that it will not come about.

(5) Many voices have been heard in our land over many years to the effect that the essential training in the high school as well as in the college can and should be done in less than the present eight years. Maybe so. It certainly can be done better, that is, more thoroughly, if we continue to use these eight years. I do not think we have as yet sufficient biological and medical information to enable us to say what amount of mental vacation is the minimum for the health of our high-school and college youth. And let us not forget that education, like the biological processes of growth, is partly a factor of time. And like growth, the educational time factor varies with the individual. In any event let us not set the limit for formal education under the stresses and hysteria of war, and let us be certain that the all-around speed-up, the longer and the more intellectually strenuous student college year does not eventuate in two degrees instead of one, the B.A. and the T.B. (tuberculosis).

(6) President Conant, of Harvard University, thinks that university students should and must decide for themselves the matter of joining our armed forces before age puts them on the call and selection for those services. With that I agree. This seems equally sound when applied to members of college and university faculties, irrespective of age. If there is a task with the armed forces that you can do better than any other man available, your duty seems clear, at least to me. But I also think that your skill and effort toward education of to-morrow's citizens are as important for our way of life and approximate justice in the world at large as gunning a German soldier or bayoneting a Japanese sailor.

(7) I have, and I do differ on many points in education with my brilliant president, Mr. Hutchins, but I see eye to eye with him on this: "What the world needs, what this country must have, is free minds—minds informed by principles derived through human experience through the ages, minds that are open no matter what waves of change beat upon them." The duty and the responsibility of aiding in the maturing of such minds rest in no small part on the university, in times of peace and in times of war. This is no mean service, if we give our all. For war creates special follies and dangers for the years that follow war. One of these is the hope that Utopia can be created by hate and violence, that war can establish "freedom from want and freedom from fear" for all men. This delusion, however useful in war, will endanger the peace, for which we are supposed to fight. We of the faculties could aid the next generation by example, by ourselves winnowing the war time propaganda chaff from the wheat of cold realism. We might also, for the better day, when the dawn of peace shall once again brighten our land, re-examine one recent trend, one segment of recent socio-economic philosophy, to wit: Our youths must be shielded from real work, from all individual social and economic responsibilities till they are 18 to 21 years of age; and, at the other end of the life span, people past 50 or 60 years of age should be cut off from work and responsibility, and supported in idleness on public pensions. Is this the best we can do for to-morrow? I think that this philosophy is unbiological, anent both ends of the life span; and instead of being kind and wise, I think that it is both cruel and stupid. This is just one of the many difficult problems before us, calling for the degree C.T.C. —clear thinking and courage. How many of us live up to that degree even during the 40-hour week?

I have presented some duties and some dont's for us, that is, the university in the present crisis. Both have been put more clearly by others. I quote from an outstanding member of our association, Professor Zechariah Chaffee, Jr., of Harvard University:

> Most of all, we need an immense amount of thinking and talking about the kind of world we want after the war. Victory is not enough unless it brings a just and enduring peace. American civilization can not stand an endless outpouring of billions for defense during a patched-up peace. The problem is enormously difficult. In 1919 we tried to put together the pieces and failed. Now there are very few pieces to put together. There will have to be a big, fresh start, and its success will depend on the continued support of the American people for a good many years after the fighting is over. Any plan framed by a few leaders, however wisely, will fail unless it responds to widespread thoughts and desires of us ordinary men and women. Whatever plan is proposed will involve drawbacks, and citizens must first have become ready to accept those drawbacks as preferable to the horrors of a third World War. That means they must be made thoroughly aware through long discussion in speech and print of the nature of the plan. The seed Wilson sowed was perhaps better than we knew in the short time it was before us. At all events, it fell on

thin soil and was blown away. If the new seed of 1943 or 1944 or 1945 is to take firm root, the soil must first be ploughed long and deeply back and forth by the impact of ideas, until it is prepared for fertile growth. . . . Last time we forgot all this. We became so afraid of those who advocated a peace without victory that we put some of them in jail and scared the rest into silence and so we got a victory without peace. This time we must be wiser and not forget. Let us not in our anxiety to protect ourselves from foreign tyrants imitate some of their worst acts, and sacrifice in the process of national defense the very liberties which we are defending.

And this, from a university administrator, President Hutchins:

The intellectual activities of the university are the symbol of everything we have to defend. The best service we can render in the defense of our country is to see to it that those activities are maintained in full force and vigor. . . . Our basic function remains the same. Another has been superimposed upon it which will make it hard, perhaps very hard, perhaps impossible to carry on our basic function. . . . That basic function, intellectual leadership, is more difficult than ever—more vital than ever. . . . To formulate, to clarify, to vitalize the ideals which should animate mankind, this . . . is the incredibly heavy burden which rests, even in total war, upon the universities. If they can not carry it, nobody else can. If it can not be carried, civilization can not be saved.

THE UNIVERSITY AND THE WAR[1]

By Dr. ARTHUR CUTTS WILLARD
PRESIDENT OF THE UNIVERSITY OF ILLINOIS

WHAT of the university in a world at war, and the place of the university in that war? As a group, the land-grant colleges—of which the University of Illinois is one—are already in the war. They have furnished a total of 75,000 reserve officers for service in the armed forces of the United States. Prior to Pearl Harbor, over 50 per cent. of our Army officers had come from the Reserve Officers Training Corps, which is still producing more than 10,000 officers a year.

The University of Illinois has always had one of the largest Reserve Officers' Training Corps units in the country, and has never questioned its obligation to both the federal and the state governments to maintain this corps on a strictly compulsory basis. At present there are over 4,200 students enrolled in the military classes, 600 of whom are in the advanced course and about 300 are in line for commissions in June as U. S. Army Officers.

But what of the other obligations of the university in the emergency? Certainly no other educational institution in the State of Illinois is faced with a greater responsibility to serve in every possible way to help win this war. It should be obvious that our most effective resources are to be found in the fields of teaching and research. In those areas we have had experience and success. We have a large and competent staff, an extensive and well-equipped plant; all of which are now at the disposal of the government for whatever war-time service is most appropriate.

"Education as usual" is, in many situations, no longer possible, and a state university should be one of the first institutions to accept this fact, and adjust its program accordingly. In my opinion, it is the first concern of the University of Illinois to help win the war. Everything else is secondary, even the much-talked-of long-time educational program so essential for making a durable peace.

Our programs of teaching and research have already been readjusted to produce more graduates in all fields in less time. Our Colleges of Medicine, Dentistry, and Pharmacy in Chicago have adopted a four-quarter system, and the colleges and schools in Urbana-Champaign have provided for an intensive summer quarter of 12 weeks in which a student can acquire full semester credit.

Nor is this the only departure from normal, as students called under the Selective Service Act may, if in good standing, receive course credit for the balance of any semester or even get their degrees if called for war service during their final semester.

Many new courses have already been established or existing courses have been specially adapted to meet the professional demands for various war services. As typical of the latter, the university is providing and teaching complete curricula in many of its colleges to permit young men from 17 to 19 years of age to enlist in the U. S. Navy under the new (V-1) program. This does not resurrect the old Students Army Training Corps. It does not put the men in college into uniform nor does it require naval drill.

There can be no question as to the importance of physical fitness for all of us in the struggle ahead, and the School of Physical Education at the university is already offering all its facilities for meeting this more serious threat to the sturdiness of our manpower.

Reference has already been made to the competence

[1] Excerpts from an address given in Chicago on February 26, at the Washington Award dinner of the Western Society of Engineers.

of the faculty and staff as an important resource for war-time service, both on and away from the campus. To make such service most effective and readily available, the board of trustees has made it possible for faculty and staff members to retain their positions through leaves of absence without pay when called into the military and naval service of the United States or into service essential to the prosecution of the war. The number of persons now on leave in these services exceeds 100 for military service and about 20 for defense projects, in addition to 42 who have resigned.

The University of Illinois has already made a special contribution to the war program of this country through the many notable research activities of its scientific staff both past and present. The Engineering Experiment Station is the oldest in the United States and probably the most active, and the Agricultural Experiment Station is one of the nation's oldest and most active. Both independently of, and in cooperation with, various departments of the Federal Government, these stations are making important researches in many fields closely related to the war activity. Of even greater significance in directly aiding the Army and Navy are the research activities of the departments of physics and chemistry. I also must mention the research and war service of the professional faculty in medicine, dentistry and pharmacy, of whom 42 are now on leave or resigned for military or naval service.

The university has two important extension organizations for rendering off-campus war-time service. The Extension Service in Agriculture and Home Economics has a staff of trained specialists who can present and interpret to the people the results of scientific research carried on by the Agricultural Experiment Station, often in cooperation with the U. S. Department of Agriculture. The Division of University Extension has been most active in making many of the resources of the university available to the entire State of Illinois. The work of this division in the field of help to industry and other activities related to the war has been in progress for many months and is very comprehensive in its scope.

(A) Most impressive is the Engineering, Science and Management Defense Training Program. Under this program, training at the college level in engineering, chemistry, physics and production management is provided in those industrial areas of the state that are in the battle of production. At this time there are in operation 28 different courses in 23 Illinois communities, for a total of 176 classes and an enrolment of 4,545 students.

(B) The Division has provided courses in conversational Spanish for the officers of the Air Corps at Chanute Field.

(C) It is having prepared by the appropriate staff members materials for courses for young men who, lacking the necessary college training for admission to the flying cadet schools of the U. S. Army, wish to prepare for the mental examination.

(D) It operates a Speakers' Bureau, an important contribution to the maintenance of civilian morale.

(E) There has been created a state-wide school and college civilian morale service to work in conjunction with the Office of Civilian Morale in Washington and the U. S. Office of Education.

(F) The Visual Aids Service of the division has acquired and is distributing motion picture films for exhibition in the classrooms on subjects that contribute to the understanding of and loyalty to fundamental American ideas and ideals.

(G) The division sponsors a research project in adult education that has been engaged in the preparation of materials and the training of teachers for the education of the foreign-born under the auspices of the U. S. Department of Justice.

(H) It conducts a number of institutes and conferences, several of which recently have been concerned with the problem of defense.

(I) Men in the armed forces, whose education is interrupted by their calls to service, are afforded opportunity to make some progress toward college degrees by the university courses that are taught by correspondence.

(J) In conjunction with the University Library, the division has projected a series of reading lists on the understanding of America, its aims, the war and the peace to follow.

The university radio station has been using all programs of a national defense nature that can be integrated with its own comprehensive 12-hour-a-day educational programs.

To maintain coordination of the many new war activities with the normal activities of the university, a Central War Emergency Committee was set up as soon as war was declared. This committee is both a clearing center and a policy recommending body of the greatest value to the administration of the university.

OBITUARY

ROBERT WILLIAM HEGNER

AFTER an illness of several months, Robert Hegner died on March 11, 1942, at the age of sixty-two years. With increasing weakness and suffering during the last year of his life he showed the greatest courage and cheerfulness under the most trying circumstances.

He refused to give up and kept on with his lectures and the direction of the work of his department until only a short time before his death. His was an unusually active and fruitful career. Early important researches on insect embryology and a large series of books on zoology made him well known to zoologists, and extensive researches on the parasitic protozoa and the training of numerous graduate students gave him a position of leadership in the field of parasitology.

Dr. Hegner was born in Decorah, Iowa, on February 15, 1880. As a boy he was interested in the study of birds and was a pioneer in bird photography. He received his A.B. from the University of Chicago in 1903 and started graduate work in that institution. Later he changed to the University of Wisconsin, where he received the Ph.D. in 1908. For the next eight years he was a member of the zoology department of the University of Michigan. During this period he carried on researches in invertebrate embryology and published his first book, "The Germ Cell Cycle of Animals." Here, also, he published the first edition of his "College Zoology," which is still one of the leading college texts in the field of biology. The fifth edition of this book, which was completed shortly before his death, will soon appear.

In 1918, Dr. Hegner was called to the newly organized School of Hygiene and Public Health of the Johns Hopkins University to develop the work in medical zoology. Here he found his life's work in research and teaching in the field of the parasitic protozoa. From his researches he has published over 150 papers in journals in this country and abroad both on the biological and medical aspects of protozoology, including extensive contributions on malaria and amebic dysentery. He has been especially successful in training research students; forty men and women have taken the doctorate under his direction. Some of these students have already assumed positions of leadership in the field. He also found time to continue his series of text-books in general zoology and published important books on parasitology.

Dr. Hegner was a great traveler. Besides numerous trips to Europe, on which he combined scientific activities and recreation, he traveled widely in tropical America and the Orient. He directed a number of expeditions for the study of parasitic protozoa in tropical American countries, including Puerto Rico, Honduras, Costa Rica, Panama, Guatemala and Colombia. For five months in 1926 he was visiting professor at the London School of Tropical Medicine, and he spent the year of 1929 organizing a Department of Protozoology at the School of Hygiene of the University of the Philippines. During 1938, at the request of the Government of Mexico, he spent five months at the Institute of Public Health in Mexico City, conducting research and helping in the organization of the division of parasitology. His wide e perience in the tropics with human protozoan dise influenced greatly his teaching and research. In a dition he was interested in the habits and customs the peoples he visited and brought home with extensive photographic records which were the light of his students and friends.

Dr. Hegner's varied activities also included editor work and membership in numerous scientific societ in zoology, parasitology and tropical medicine. F many years he was the editor of the Century B logical Series. He was for several years the co tributing editor of the *Quarterly Review of Biolo* and served on the editorial boards of the *Journal Parasitology, Biological Abstracts, the Journal Morphology* and the *American Journal of Hygie* He was a charter member of the American Acade of Tropical Medicine and an honorary member British and Belgian societies. In 1935 he was pre dent of the American Society of Zoologists and, 1936, of the American Society of Parasitologists. 1939 he was given the honorary degree of doctor science by Mount Union College.

Dr. Hegner had the ability, all too rare in scientis of popularizing his subject. In addition to numero magazine articles for the general public he wrote 1935 "The Parade of the Animal Kingdom," whi has been one of the most popular recent books natural history, and, in 1938, "Big Fleas Have Lit Fleas," in which in a delightfully humorous way opened up for the lay public the wonders of t parasitic protozoa.

Never satisfied with his already important accom plishments in research, Dr. Hegner was constant pushing ahead, and during the last years before h death developed in the study of bird malaria the mo important research program of his career. In h last paper, published in September, 1941, he report the very successful treatment of bird malaria with new drug which is now being tried on human malari Few men will be missed more by colleagues a friends. He was charming in all his personal rel tions, and his keen sense of humor and wide exper ence made him the most interesting and stimulating companions.

W. W. CORT

SCHOOL OF HYGIENE AND PUBLIC HEALTH,
THE JOHNS HOPKINS UNIVERSITY

W. L. SCOVILLE

DR. W. L. SCOVILLE died in Gainesville, Florida, o March 10, 1942, at the age of seventy-seven. He w born in Bridgeport, Connecticut, where he began h pharmaceutical career in a drug store. Later he e tered the Massachusetts College of Pharmacy and r ceived the degree of Ph.G. in 1889. He was profess

of pharmacy at the same institution from 1891 to 1904. From 1904 to 1907 he was an analytical chemist in Boston. He was then called to head the analytical department of Parke, Davis and Company in Detroit, in which capacity he served until his retirement in 1934.

Dr. Scoville held many important positions in national pharmaceutical bodies. He was a member of the Revision Committee of the U. S. Pharmacopoeia from 1900 to 1940. He served as vice-chairman of that committee during the period 1920–30. He was a member of the Committee of Revision of the National Formulary for the third, fourth, fifth and sixth editions. He served as chairman of the latter for the fourth and fifth revisions. His work on these two national standards for the purity of drugs was outstanding.

Dr. Scoville was awarded many honors, including the honorary doctor of science degree from the Massachusetts College of Pharmacy in 1927, the honorary master of pharmacy degree from the Philadelphia College of Pharmacy in 1929, the Ebert Prize in 1923 and the Remington Medal in 1929. He was an honorary member of the Pennsylvania Pharmaceutical Association and the Michigan Pharmaceutical Association. He was a member of the American Association for the Advancement of Science, the American Chemical Society and the American Pharmaceutical Association. He had been a member of the latter for more than fifty years. Dr. Scoville was the author of a widely used pharmaceutical text-book on the "Art of Compounding." The deceased is survived by his wife, Mrs. Lillie W. Scoville, two daughters, Mrs. Ralph D. Pearson, of Royal Oak, Mich., and Mrs. Thomas G. Spriggs, of Detroit, Mich., and four grandchildren.

P. A. FOOTE

UNIVERSITY OF FLORIDA

RECENT DEATHS

DR. ARTHUR NEWELL TALBOT, emeritus professor of municipal and sanitary engineering at the University of Illinois, died on April 3, at the age of eighty-four years.

JEROME HINDS RAMSKILL, professor of forestry at the University of Montana, died on March 31. He was sixty years old.

DR. JOSEPH BOLIVAR DE LEE, emeritus professor of obstetrics and gynecology at the University of Chicago, died on April 2, at the age of seventy-two years.

FRANCIS JAMES SELBY, from 1918 to 1932 secretary of the National Physical Laboratory, Great Britain, died on March 5, at the age of seventy-four years. He joined the staff of the laboratory in 1903 and was in charge of tide-prediction from 1903 to 1919 and of optics from 1903 to 1909. He was secretary of the Advisory Committee for Aeronautics from 1909 to 1919.

SCIENTIFIC EVENTS

THE INSTITUTE OF FOOD TECHNOLOGY

THE third annual meeting of the Institute of Food Technology will open at the Hotel Nicollet, Minneapolis, on June 15. There will be four half-day sessions, two luncheon sessions and one round-table session.

Dr. J. C. Drummond, chief scientific adviser of the British Ministry of Food, is one of the speakers at the opening session, which is devoted to various aspects of food technology.

Monday afternoon will be given over to papers on substitute materials for food processing, on Tuesday morning the dehydration of foods will be discussed, and packaging and materials will be the subject in the afternoon.

"Industrial Sabotage," by C. W. Stein, F.B.I., special agent in charge, St. Paul, Minn., will be discussed at the Monday luncheon and "Labor Relations and the Food Technologist," by N. W. Shefferman, of Sears, Roebuck and Company, Chicago, at the Tuesday luncheon session. The subject of the round-table discussion on Wednesday morning is "Educational Requirements of Food Technologists." Industrial plant trips will be arranged for those not attending the round-table session.

The address of the president, L. V. Burton, will be delivered at the banquet on Tuesday evening, when presentation will be made of the first Nicholas Appert Medal Award, sponsored by the Chicago Section of the institute.

The Institute of Food Technologists was organized in Cambridge, Mass., in July, 1939, at the close of the Second Conference on Food Technology, held under the auspices of the Massachusetts Institute of Technology. Its officers are: *Retiring-President,* Dr. S. C. Prescott, dean of science, Massachusetts Institute of Technology; *President,* Dr. L. V. Burton, editor of *Food Industries,* New York, N. Y.; *Vice-president,* Dr. E. H. Harvey, director of research, Anheuser-Busch, Inc., St. Louis, Mo.; *Secretary-Treasurer,* Dr. G. J. Hucker, N. Y. State Agricultural Experiment Station, Geneva, N. Y.

The institute's first meeting was held in Chicago from June 16 to 19, 1940, and its second meeting was in Pittsburgh, Pa., from June 15 to 18 of last year. Its growing membership consists of more than 1,200

chemists, bacteriologists, process engineers and others similarly trained or experienced in the manufacture, preservation and handling of food.

THE ASSOCIATION OF COLLEGE GEOLOGY TEACHERS

ON Friday and Saturday, April 24 and 25, Principia College at Elsah, Ill., will be host to visiting geologists from some fourteen colleges in the Middle West at the fifth annual meeting of the Association of College Geology Teachers. Dr. Percival Robertson, professor of geology at Principia and vice-president of the association, is in charge of the program.

On Friday, after inspection of the geology department and facilities of the college, a picnic luncheon will be held along the Mississippi River. The afternoon program includes presentation of papers and informal discussion on topics relating to the contributions of geologists and geology students to the war program, more effective teaching techniques and problems common to the teachers of geology in smaller institutions. In the evening the group will be guests of the college at a banquet. On Saturday morning a short field trip to survey the Pleistocene history of the region and to collect fossils from some of the Paleozoic formations will complete the schedule.

The association was formed in the fall of 1937 by a group of its present members, who met in the field at the annual Tri-State Field Conference of Geologists from Illinois, Iowa and Wisconsin. The first meeting was held at Augustana College, Rock Island, Ill., in the spring of 1938 under the leadership of Professor Fritiof Fryxell, of Augustana College, its first president. Since then Cornell, Beloit and Lawrence Colleges have been hosts to the association.

The purposes of the association are: to foster unity and cooperation among college teachers in the earth sciences; to promote high standards of college instruction in this field; to emphasize the cultural significance of earth sciences, and to disseminate accurate geologic knowledge to the public. Papers presented at the meetings are devoted to consideration of problems and procedures in attaining these ends, rather than to presentation of new research results in geologic investigations. Any college faculty member whose duties involve the teaching of some aspect of earth science is eligible for election to membership.

A committee of the association has prepared a comprehensive list of popular and semi-popular books on geologic subjects that has proved useful as a guide to leisure reading for the layman and as collateral reading for the non-professional student. Another valuable service of the organization to its membership is the exchange of geologic specimens and teaching materials, which is a feature of the annual meetings.

Teachers of earth sciences in other colleges of the Middle West who may be interested in membership are urged to communicate with Dr. Lincoln R. Thiesmeyer, associate professor of geology at the Illinois Institute of Technology, Chicago, who is president of the association. The establishment of branches in other sections of the country is also under consideration.

Those wishing to attend the coming meeting should communicate with Professor Percival Robertson, department of geology, The Principia, Elsah, Ill., or with the secretary, David M. Delo, Knox College, Galesburg, Ill., to make arrangements for meals and lodging accommodations.

THE NINETEENTH COLLOID SYMPOSIUM

THOSE planning to attend the Boulder, Colo., Colloid Symposium, held under the auspices of the Committee of Colloid Science of the National Research Council and the Colloid Symposium Committee of the Colloid Division of the American Chemical Society, will be interested in knowing of housing facilities in and near Boulder. Early reservations are advised, since Colorado is a popular vacation center, and no one knows what to expect in the way of travel this summer. The University of Colorado Summer Session, usually enrolling over 4,000, promises to be large in addition to the fact that numerous conventions will be held in Boulder.

Rooms at the Boulderado Hotel, the Albany Hotel and the Monticello Hotel range from $1.25 single to $4.50 double. Blanchard's Lodge is situated three and a half miles up Boulder Canyon and has both rooms and cottages available at prices ranging from $1.25 single to $3.00 double.

Estes Park and Estes Park Village are thirty-one miles to the northwest of Boulder on a beautiful, paved, easy ascent mountain highway, and Denver is thirty-two miles southeast on a paved, plains highway. Good hotels are available at both places. The Boulder, Estes Park or Denver Chambers of Commerce will be pleased to send descriptive literature, lists of hotels and cottage camps to any one writing to them.

Information in regard to housing facilities can be obtained from the hotels. Other information regarding the symposium can be obtained from Dr. Frank E. E. Germann, Boulder, Colorado.

PACIFIC DIVISION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE twenty-sixth annual meeting of the Pacific Division of the American Association for the Advancement of Science and the one hundred and eleventh meeting of the association will be held at Salt Lake City from June 15 to 20. It will be sponsored by the Utah Academy of Sciences, Arts and Letters, the

Utah State Agricultural College, the Brigham Young University, the Weber Junior College and the University of Utah.

Officers of the division are:

President: D. R. Hoagland, University of California, Berkeley; *Vice-president:* Roy E. Clausen, University of California, Berkeley; *Secretary-Treasurer:* J. Murray Luck, Stanford University.

Members of the executive committee are:

Chairman: Roy E. Clausen, University of California, Berkeley; D. R. Hoagland, University of California, Berkeley; Ian Campbell, California Institute of Technology, Pasadena; J. Murray Luck, Stanford University; R. C. Miller, California Academy of Sciences, San Francisco; A. R. Moore, University of Oregon, Eugene; H. S. Reed, University of California, Berkeley; F. B. Sumner, Scripps Institution of Oceanography, La Jolla; Thomas G. Thompson, University of Washington, Seattle; C. L. Utterback, University of Washington, Seattle.

A general reception for members of the association and associated societies and their guests will be given on June 17 by the president of the University of Utah, Dr. LeRoy E. Cowles, and Mrs. Cowles, in the Union Building, University Campus.

There is planned on June 16 a symposium on "The Great Basin, with Emphasis on Glacial and Postglacial Times," in which Dr. Eliot Blackwelder, of Stanford University, Drs. C. L. Hubbs and R. R. Miller, of the University of Michigan, and Dr. Ernst Antevs, of Arizona, will take part. In the afternoon there will be a session devoted to reviews of current research. The presidential address of Dr. Hoagland will be delivered in the evening.

Dr. Hazel K. Stiebeling, senior food economist of the U. S. Department of Agriculture, will speak on "Nutrition in War Time" on Wednesday evening, June 17.

Excursions have been planned to afford an opportunity to become acquainted with the unique features of the region, such as Great Salt Lake, the Utah Copper Mine—the largest open-cut copper mine in the world—and with the well-preserved features of prehistoric Lake Bonneville. The moraines and other glacial features of the near-by Wasatch Mountains will also be visited. Trips are also planned to Brigham Young University at Provo and Utah State Agricultural College at Logan.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting of the American Philosophical Society, Philadelphia, will be held on April 23, 24 and 25 in the hall of the society in Independence Square, Philadelphia.

Sessions for the reading of papers will be held on Thursday and Friday mornings and afternoons and on Saturday morning. These will be presided over, respectively, by Roland S. Morris, president of the society, and by Vice-presidents Dr. Frank R. Aydelotte, of the School for Graduate Studies at Princeton; Dr. Edwin G. Conklin and Professor William E. Lingenbach, of the University of Pennsylvania. On Thursday, the program will center around recent advances in American archeology.

The Franklin Medal Lecture will be given in the evening by Dr. Sylvanus Griswold Morley, associate in American archeology of the Carnegie Institution of Washington. He will describe the work of the institution in Central America and Mexico. The lecture will be followed by a number of round-tables.

The meeting of the executive session has been placed on Friday morning, when the annual report of the president, Roland S. Morris, will be presented, and the election of officers, councilors and members will take place. The executive session will be followed by a luncheon for members and invited guests.

The R. A. F. Penrose, Jr., Memorial Lecture will be given on Friday evening by Dr. James R. Angell, president emeritus of Yale University and educational councilor of the National Broadcasting Company. He will speak on "Education in a World at War." The lecture will be followed by a reception. Earlier in the evening the initial broadcast of the society will be heard over Station WRUL. On Saturday afternoon there will be an excursion and reception. The proceedings will close on Saturday evening with the annual banquet in the Hotel Bellevue-Stratford.

SCIENTIFIC NOTES AND NEWS

THE Dental Science and Dental Arts Grant-in-Aid Award of the International Association for Dental Research was presented, at the recent New York meeting, to Dr. A. H. Kniesner, of the Dental School of Western Reserve University.

DR. GEORGE R. COWGILL, associate professor of physiological chemistry at Yale University and editor of the *Journal of Nutrition,* has been awarded the Mead Johnson and Company Prize of $1,000 by the American Institute of Nutrition for researches dealing with the B-complex vitamins.

DR. EARL A. EVANS, JR., associate professor of biochemistry at the University of Chicago, has been awarded by the American Chemical Society the 1942 Eli Lilly Prize of $1,000 in biological chemistry. The award is in recognition of his work on the role of

carbon dioxide in the animal body. The prize will be presented at the Memphis meeting on April 20.

AT the annual meeting on March 30 and 31 of the Society of Experimental Psychologists, the 1942 award of the Howard Crosby Warren Medal was made to Professor B. F. Skinner, of the University of Minnesota, "for his experimental analysis of laws operating in one type of conditioning."

THE Keith Prize of the Royal Society of Edinburgh has been awarded for 1939–41 jointly to Professor E. T. Copson, of University College, Dundee, and to Professor W. H. McCrea, of Queen's University, Belfast, in recognition of their contributions to the theory of Riemannian space and general relativity. The Neill Prize for the same period has been awarded jointly to Dr. P. C. Koller, of the Institute of Animal Genetics, University of Edinburgh, for his contributions to cytology, and to Dr. W. J. McCallien, of the department of geology, University of Glasgow, for his work on tectonic geology of the Scottish Highlands.

THE degree of doctor of science has been conferred by the University of Oxford on the Reverend Theodore Evelyn Reece Phillips, the rector of Headley, Epsom; in 1927 and 1928 president of the Royal Astronomical Society.

Nature reports that Lieutenant-General A. G. L. McNaughton, recently commander of Canadian troops in Great Britain, has been elected an honorary member of the Institution of Electrical Engineers, in appreciation of the outstanding services rendered by him to promote the practical application of science to industry, especially his work on high-voltage research during his presidency of the Canadian National Research Council.

AT a recent meeting of the Board of Trustees and Scientific Governors of the Chicago Academy of Sciences, Dr. Orlando Park, professor of zoology at Northwestern University, was elected a life member and honorary curator of zoology. Other elections were: *Honorary Member,* Dr. Charles H. Behre, professor of geology, Columbia University; *Life Members,* Fred Gibson, director of the Boyce-Thompson Southwestern Arboretum, Roy Komarek and Edward Komarek, and *Patron,* Henry B. Babson.

GEORGE A. SLOAN, commissioner of commerce of New York City, a former president of the Cotton Textile Institute, has been named president of the Nutrition Foundation, Inc. Charles G. King, of the University of Pittsburgh, has been made scientific director in charge of research. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, is chairman of the board of directors and Ole Salthe has been appointed executive secretary.

OFFICERS for 1942 were elected by the Torrey Botanical Club at its meeting in January as follows: *President,* Dr. C. Stuart Gager, Brooklyn Botanic Garden; *1st Vice-president,* Dr. John A. Small, New Jersey College for Women; *2nd Vice-president,* Dr. F. Clyde Chandler, New York Botanical Garden; *Corresponding Secretary,* Dr. Harold C. Bold, Barnard College, Columbia University; *Recording Secretary,* Miss Honor M. Hollinghurst, New York City; *Treasurer,* Dr. W. Gordon Whaley, Barnard College, Columbia University; *Business Manager,* Dr. Michael Levine, Montefiore Hospital; *Bibliographer,* Mrs. Lazella Schwarten, New York Botanical Garden; *Editor of the Bulletin and Memoirs,* Dr. H. W. Rickett, New York Botanical Garden; *Editor of Torreya,* Dr. William J. Bonisteel, Fordham University.

DR. EDWARD B. HOLLAND, research professor of chemistry at the Massachusetts State College at Amherst, has retired after a service of nearly fifty years.

PROFESSOR ALBERT BALL, head of the department of physics at Cooper Union, New York City, will retire on June 30, after thirty-seven years of service.

DR. ALEŠ HRDLIČKA retired, on March 31, as curator of the Division of Physical Anthropology in the U. S. National Museum, when he completed thirty-eight years and eleven months of active service with the Smithsonian Institution. As a token of the esteem of the institution he has been appointed an associate in anthropology and will continue his scientific research and serve in an advisory capacity. On April 1 Dr. T. Dale Stewart was promoted to the curatorship and administrative head of the Division of Physical Anthropology, with which he has been associated since 1924.

DR. MYRON GORDON, formerly in charge of the Fish Genetics Laboratory of the Departments of Zoology and Plant Breeding at Cornell University, recently fellow of the John Simon Guggenheim Memorial Foundation, has been appointed research associate in genetics in the New York Zoological Society and has been elected a fellow of the society. Dr. Gordon is in charge of laboratories for genetic and correlated studies in fishes which are in the Whitney Wing of the American Museum of Natural History.

DR. RALPH E. MILLER, associate professor of pathology and assistant dean of Dartmouth Medical College, Hanover, has been chosen president of the New Hampshire State Board of Health to succeed Dr. George C. Wilkins, Manchester, who has retired after serving in this capacity for many years.

PARKE, DAVIS AND COMPANY, Detroit, and Eli Lilly and Company, Indianapolis, Indiana, have offered to sponsor, jointly, in the amount of $4,000 each, research

on ergot substitutes directed by Professor Frederick F. Blicke, of the University of Michigan.

THE South Dakota Academy of Science will meet in Vermillion at the University of South Dakota on May 1 and 2. Dr. Walter F. Loehwing, head of the department of botany at the State University of Iowa, will speak on "Recent Advances in Botanical Research."

THE annual Edward Gamaliel Janeway Lectures at Mount Sinai Hospital were delivered by Dr. Michael Heidelberger, associate professor of biochemistry at the College of Physicians and Surgeons, Columbia University, on April 7 and 10. His subject was "Newer Concepts of Infection and Immunity and Chemistry's Part in Their Development."

DR. THOMAS FRANCIS, JR., professor of epidemiology at the School of Public Health, University of Michigan, addressed the University of Cincinnati Section of Sigma Xi on March 25. He spoke on "Immunity to Epidemic Influenza."

DR. JEAN PERRIN, French physicist and Nobel laureate, is delivering a series of lectures on the atom at Wilson College, where he is a guest scholar this semester. Dr. Perrin is also dean of sciences and medicine in the Franco-Belgian Institute for Advanced Studies in New York City.

THE thirteenth scientific meeting of the Association for Research in Ophthalmology will be held in Atlantic City on June 9, at the Marlborough-Blenheim Hotel.

THE Long Island College of Medicine is introducing a series of visiting professorships, financed from the Commonwealth Fund, of $4,500 a year for three years. It is planned to invite scholars from other institutions for short periods to make specific contributions to the curriculum. Dr. Thomas Addis, of Stanford University School of Medicine, is the first lecturer under the new plan. He will remain for six weeks as the guest of Dr. Tasker Howard, professor of medicine. Dr. Wilson G. Smillie and members of his staff at Cornell University Medical College have accepted the invitation of Dr. Wade W. Oliver, professor of bacteriology, to give in the spring a course in parasitology and tropical medicine to the second- and third-year classes.

A CHAPTER of the Society of Sigma Xi has been installed at Louisiana State University. Addresses were made at the installation ceremony by Dr. Edward Ellery, of Union College, and Dr. Herbert McLean Evans, of the University of California.

REPRINTS of the articles that appeared in *Chemical and Engineering News* for January 10 and 25 on "Industrial Research in the United States and Foreign Countries in 1941" by William A. Hamor, Mellon Institute, Pittsburgh, are being distributed on request free of charge to those who are interested.

THE Institute of Medicine of Chicago offers its annual Joseph A. Capps Prize for medical research of $400 for 1942 for the most meritorious investigation in medicine or in the specialties of medicine. The investigation may also be in the fundamental sciences provided the work has a definite bearing on some medical problem. Competition is open to graduates of Chicago medical schools who completed their internship or one year of laboratory work in 1940 or thereafter. Manuscripts must be submitted to the Secretary of the Institute of Medicine of Chicago, 86 East Randolph Street, not later than December 31, 1942.

THE *Journal* of the American Medical Association states that as a result of the decision of the fourth Brazilian Congress of Ophthalmology, held in Rio de Janeiro in July, 1941, the Brazilian Council of Ophthalmology has been founded. The chief functions of the council are: (1) to promote the development and progress of the specialty in Brazil and to establish standards of fitness to practice ophthalmology, (2) to act as preceptors for prospective students of ophthalmology and (3) to arrange and conduct examinations to test the qualifications of those who practice ophthalmology and desire a certificate to prove that they meet the standards established by the council. The council will be formed by the professors of ophthalmology from the medical schools of Rio de Janeiro, São Paulo, Bahia, Porto Alegre, Recife and Bello Horizonte and the presidents of the Brazilian Association of Ophthalmology and of four other state ophthalmologic associations. There will be a central executive board and a regional board in each one of the twenty states of Brazil.

STATISTICS will be emphasized in the first summer session, June 8 to July 15, of the Iowa State College at Ames. Courses in the mathematical theory of statistics and its applications will be offered by the regular staff, supported by five visiting lecturers—Professors Gertrude M. Cox, F. R. Immer, E. J. Kraus, P. R. White and Dr. W. J. Youden. The design of experiments and of other sampling investigations important in the present emergency will receive special consideration. The departments of agronomy, animal husbandry, botany, economics and sociology, foods and nutrition, genetics, horticulture and mathematics are cooperating, the effort being sponsored by the Statistical Laboratory.

GIFTS to the University of Michigan from the W. K. Kellogg Foundation include $2,228 to publish "Community Workshop for Teachers in the Michigan Community Health Project," as one of the Mono-

graphs on Education; $113,000 for the purchase of equipment for undergraduate students in the School of Dentistry and for alterations and additional equipment in the undergraduate laboratories and clinics, and $35,000 for a program of rehabilitation of the facilities of the Department of Pediatrics and Communicable Diseases.

Nature writes: "The January issue of the *Anglo-Swedish Review* announces that the Bergianska Trädgärden or Bergianum, the botanical garden of Stockholm, is to mark its hundred and fiftieth anniversary this year. It was founded in 1791 by Peter Jonas Berg, a doctor of medicine and a botanist, who bequeathed it to the Swedish Academy of Science. It consists of a purely scientific botanical section and a practical section, which in peace-time carries on a large exchange of seeds with most of the botanical gardens abroad. Among the latter is the botanical garden of Tokyo, which had to place considerable orders to complete its collections, part of which were destroyed in the earthquake ten years ago. The Bergianum is also in close touch with the United States, and some plants from the salt steppes of Russian Turkestan recently came from Russian botanical gardens. Most of the seeds received are of purely scientific interest, but sometimes seeds and plants of commercial value are also received. The results of experiments on the effects of the vigorous cold of the last two years on different plants will shortly be published in *Acta Horti Bergiani,* which contains the results of research work in systematics, cytology and embryology. The celebrated collection known as 'Iconotheca Botanica Bergiana' contains 10,000 photographs by most of the botanists in the world."

DISCUSSION

THE EARLIEST ACCOUNT OF THE ASSOCIATION OF HUMAN ARTIFACTS WITH FOSSIL MAMMALS IN NORTH AMERICA

ON Saturday, 12 January, 1839, the following communication appeared in *The Presbyterian,* a weekly newspaper published at Philadelphia:

THE MAMMOTH

It is with greatest pleasure, the writer of this article can state, from personal knowledge, that one of the largest of these animals, has actually been stoned and buried by Indians, as appears from the implements found among the ashes, cinders and half burned wood and bones of the animal. The circumstances are as follows:

A farmer in Gasconade county wished to improve his spring, and in doing so, discovered, about five feet beneath the surface, a part of the back and hip bone. Of this I was informed by Mr. Wash, and not doubting but the whole, or nearly the whole skeleton might be found, I went there and found as had been stated, also a knife made of stone. I immediately commenced opening a much larger space; the first layer of earth was a vegetable mould, then a blue clay, then sand and blue clay. I found a large quantity of pieces of rocks, weighing from two to twenty-five pounds each, evidently thrown there with the intention of hitting some object. It is necessary to remark, that not the least sign of rocks or gravel is to be found nearer than from four to five hundred yards; and that these pieces were broken from larger rocks, and consequently carried here for some express purpose.—After passing through these rocks, I came to a layer of vegetable mould; on the surface of this was found the first blue bone, with this a spear and axe, the spear corresponds precisely with our common Indian spear, the axe is different from any one I have seen. Also on this earth was ashes nearly from six inches to one foot in depth, intermixed with burned wood, and burned bones, broken spears, axes, knives, &c. The fire appeared to have been the largest on the head and neck of the animal, as the ashes and the coal were much deeper here than in the rest of the body; the skull was quite perfect, but so much burned, that it crumbled to dust on the least touch; two feet from this, was found two teeth broken off from the jaw but mashed entirely to pieces. By putting them together, they showed the animal to have been much larger than any heretofore discovered. It appeared by the situation of the skeleton, that the animal had been sunk with its hind feet in the mud and water, and unable to extricate itself, had fallen on its right side, and in that situation was found and killed as above described, consequently the hind and fore foot on the right side, were sunk deeper in the mud, and thereby saved from the effects of the fire; therefore I was able to preserve the whole of the hind foot to the very last joint, and the fore foot all but some few small bones that were too much decayed to be worth saving. Also between the rocks that had sunk through the ashes, was found large pieces of skin, that appeared like fresh tanned sole leather, strongly impregnated with the ley from the ashes, and a great many of the sinews and arteries were plain to be seen on the earth and rocks, but in such a state as not to be moved, excepting in small pieces, the size of a hand, which are now preserved in spirits.

Should any doubts arise in the mind of the reader, of the correctness of the above statement, he can be referred to more than twenty witnesses, who were present at the time of the digging.[1]

The author of this communication was Albert C. Koch, fossil-hunter and proprietor of a museum at St. Louis, Missouri. Koch made a living by exhibiting his fossil collections all over America, in the British Isles and in Germany, and by selling to museums. He was greatly respected by his contemporaries, and tribute to his scientific honesty was paid

[1] *The Presbyterian.* Philadelphia and New York, Saturday, 12 January, 1839, 9: 2, whole no. 413, p. 8.

by no less a person than Richard Owen, the great English comparative anatomist. But American scientists of a later generation looked askance upon this "traveling salesman and publicity boy"; he was regarded as definitely not "quite. . . ." Furthermore, there was no precedent for such a discovery as he claimed to have made. For these reasons a great deal of ingenuity was spent in discrediting both Koch and his claims. No one made the slightest attempt to check Koch's claims on the spot, and no one exhibited the least interest in examining the artifacts which Koch claimed to have discovered, in spite of the fact that he took considerable pains to make their whereabouts quite clear.

The skeleton to which Koch refers was purchased in 1843 by the British Museum, where it now is. Up to the time of its discovery, and for long afterwards, it represented the most perfect specimen of *Mastodon giganteum* in existence. The human artifacts and other remains found with this creature, and those found a year later with another *Mastodon*, were sold to the Royal Museum of the University of Berlin.[2]

For reasons which reflect little credit upon those guilty of such name-calling Koch has in the present century been referred to as a "Munchausen" with too vivid an imagination. The fact is that any one reading Koch's own accounts in the light of the discoveries made within the last fifteen years in North and South America would be compelled to credit him either with supernatural powers or else with the intelligence to observe clearly and to describe carefully what he had found, for claims such as Koch's have since been made and independently confirmed down to the last detail in many parts of North and South America.

A complete account of Koch's important discoveries together with an analysis of them and his critics' criticism is being prepared for publication elsewhere. It is here only necessary to remark that the evidence presented by Koch was, and is, unequivocally clear, and indisputably renders his the earliest discovery and account of the association of human artifacts with fossil mammals in North America.

I am extremely grateful to Mr. C. Bernard Peterson, the able assistant librarian of the Philadelphia Academy of Natural Sciences, for bringing Koch's pamphlet of 1841 to my attention, an act which led to those further inquiries which, when published, will completely serve to vindicate Koch and his discoveries.

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[2] Albert Koch, "Description of the Missourium, or Missouri Leviathan; Together with its supposed habits, Indian Traditions concerning the location from whence it was exhumed; Also, Comparisons of the Whale, Crocodile, And Missourium, with the Leviathan, As described in the 41st chapter of the Book of Job." 1st Edition. St. Louis: Printed by Chas. Keemle, No. 22 Olive Street. 1841. (On the yellow cover of the pamphlet the date is printed "1840.") 8vo. 2nd Edition, Enlarged. Louisville, Ky. Prentice and Weissinger, Printers, 1841. 8vo. A. C. Koch, "Mastodon Remains, in the State of Missouri, together with Evidences of the Existence of Man contemporaneously with the Mastodon." *The Transactions of the Academy of Science of St. Louis.* St. Louis, 1857, vol. 1, pp. 61–64.

RETURN OF A MARKED SALMON FROM A DISTANT PLACE

Search and inquiry[1] failed to reveal a single clear case of return of a salmon from a distant place in the sea to its home stream. Nor did the subsequent symposium on salmon migration[2] elicit such a case, but rather it emphasized the importance of marking salmon before they had left their rivers to determine where those from a certain river actually are to be found in the sea and of tagging them as found to test their return to the home stream.

Of 31,359 Atlantic salmon smolts, marked during descent of the Northeast Margaree River, Cape Breton, as smolts in 1938 by removal of the adipose fin, recaptures were reported of 581 of these in 1940 and 410 in 1941 in the waters of western Cape Breton and the neighboring mainland of Nova Scotia as far as Pictou and Guysborough. Dr. A. A. Blair, of the Newfoundland Fisheries Research Institute, has very kindly furnished details for a single one taken at Bonavista on the east coast of Newfoundland and tagged and released by him on June 17, 1940. It was taken again, on September 21, 1940, by an angler, Mr. M. R. Jackson, in the Northeast Margaree River above where it had been marked. The distance for this return through the sea is at least 550 miles, and Bonavista is alongside the Labrador current, very remote from any influence of the Margaree River that might aid the return. This was the only one of the marked salmon reported from Newfoundland waters and apart from the question of precise migration, the chances of its capture in either place were assuredly very small.

In agreement with the rarity of tagged, Margaree salmon kelts on the east coast of Newfoundland,[3] this was the only marked fish among the 65 salmon larger than grilse and a larger number of grilse tagged at Bonavista (grilse are very rare among the Margaree salmon). This indicates that it was far away from the bulk of the marked fish, which were evidently congregated (458 taken in 1940 and 266 in 1941) along the 16-mile stretch of coast, largely north of the river mouth, where is the definite zone of influence of the Margaree River.

We can not know what course this fish took in its

[1] A. G. Huntsman, Science, 85: 313–314, 1937.
[2] Public. No. 8, Amer. Assoc. Adv. Sc.: 1–106, 1939.
[3] A. G. Huntsman, *Jour. Fisher. Res. Bd. Can.*, 4: 96–135, 1938.

return, and other recaptures of those tagged at Bonavista do not help us since they were on the Labrador coast to the north as well as on both Newfoundland and Canadian coasts. That return may not be direct is evidenced by double recaptures of salmon tagged on the Norwegian coast,[4] which revealed a to and fro movement of even more than fifty miles. That return was probably not direct is shown by marked Margaree fish tagged on the Margaree coast in 1941 moving only (so far as definitely revealed) away from the river, even past other salmon rivers.

Such maturing salmon have been proved to move in one direction or another as much as 28.9, 35 and 62 miles per day.[5,6,7] Also it seems quite definite that they tend to remain in river water,[8] and their usual tendency to ascend the home stream when a choice is presented where two estuaries fork[9] may be due to their remaining in water from the home river—rather than in that from another river.

Is this case to be taken as representing a regular precise migration of Margaree salmon to the waters east of Newfoundland and back, or did this fish wander from the others and get back a distance of 550 miles in 96 days or less by more or less random movements and by tending to remain in river water, particularly from its home river? The facts for our salmon do not harmonize with the conception of a somewhat precise mass migration to a distant feeding ground, but they give no indication as to the degree of success in return from distant places. Much more work needs to be done.

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HATCHING OF THE BLUE CRAB, CALLINECTES SAPIDUS RATHBUN[1]

SINCE 1940 efforts have been made to devise a method for hatching eggs of the blue crab, *Callinectes sapidus* Rathbun, in the laboratory and in nature on a large scale. The egg mass or "sponge" contains upward to two million eggs. When once it was found possible to hatch large quantities of eggs to the first true zoea stage, attempts were made to induce further normal development of these zoeae.

In 1940, positive hatching results were obtained by removing masses of eggs, about one cubic inch in size, from a single "sponge" and placing them in large well-aerated tubs, in some of which the water circulated slowly while in others the egg masses were moved through the water so as to simulate natural conditions. Considerable numbers of eggs were hatched under these conditions, but numerical counts were not made to indicate the percentage that hatched into either the prezoeal stage or the first true zoeal stage.

In 1941, it was found that "sponges" may be removed from freshly gathered crabs in the field or from those that have been brought to a commercial crab house, transferred to the laboratory, cut up into small pieces and hatched out in shallow pans. Under favorable conditions, the percentage of eggs that hatched into the first true zoeal stage was 90. When hatching occurred under unfavorable conditions, the larvae usually emerged bearing one or both of the following: inner egg shell membrane and the prezoeal skin.

Under laboratory conditions, it was possible to rear the larvae from the first true zoeal stage to the second stage. This provides a positive basis for identifying these zoea of the blue crab in plankton. Reasonably certain recognition of further zoeal stages of this species should be possible by using the characters recently listed by Aikawa.[2]

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THE PERIOD OF GONADAL ACTIVITY IN THE MARYLAND MUSKRAT

AS part of a program to investigate reproduction in the muskrat, an extensive histological study has been made of the ovaries and testes of the adult Maryland muskrat. The following preliminary statement is based on the results of examination of sample 8 μ sections of one testis and epididymis from each of 222 male reproductive tracts and of complete serial 10 μ sections of one or both ovaries from 340 female reproductive tracts. The animals were trapped at frequent intervals throughout several years on the Blackwater Migratory Bird Refuge near Cambridge, Maryland. The principal purpose of the study was to determine the periods of gonadal activity and inactivity in the Maryland muskrat as indicated by the presence or absence of spermatogenesis and ovulation in the specimens studied. This report constitutes a summary of the findings; the details will be published elsewhere.

[4] Knut Dahl, *Salm. Trout Mag.*, 88: 229–234, 1937.
[5] D. L. Belding and G. Préfontaine, *Contr. Inst. Zool. Univ. Montr.*, 3: 1–58, 1938.
[6] W. J. M. Menzies, *Fisher. Scotl. Salm. Fish.*, 1937, No. 1: 1–17, 1937.
[7] K. Dahl and S. Sømme, *Norsk. Vid.-Ak. Oslo, Mat.-Nat. Kl.* 1935, No. 12: 1–27, 1936.
[8] A. G. Huntsman, *Bull. Biol. Bd. Can.*, 51: 1–20, 1936.
[9] H. C. White, *Jour. Biol. Bd. Can.*, 2: 391–400, 1936.
[1] Contribution Number 8 of the Virginia Fisheries Laboratory and the Department of Biology, College of William and Mary.
[2] H. Aikawa, *Rec. oceanogr. Works Japan*, 9: 87, 1937.

Spermatogenesis was found to begin rather abruptly in the middle of December. In the great majority of animals, large quantities of sperm were found in both testes and epididymides from the beginning of January until the beginning of October, when spermatogenetic activity began to decrease. No indication of spermatogenesis and very little sperm storage were observed in the reproductive tracts of the 24 males trapped between October 22 and November 26. Similar inactivity was noted in all but three of the 21 males trapped between November 27 and December 11; spermatogenetic activity was limited in the three exceptional males.

Study of the serially sectioned ovaries involved a search for ripe follicles and particularly for corpora lutea as indicators of imminent or actual ovulation, respectively. Although present in one or both ovaries of four of the 54 females trapped between January 21 and February 15, corpora lutea did not make their appearance in a significant number of cases until the latter part of February. Corpora were present thereafter in significant numbers of specimens until the last part of October. There was no evidence of ovulation in the 69 female tracts from animals taken between October 29 and January 14, with the exception of one pregnant animal trapped on December 11.

Cognizance must be taken of the probability that there are minor variations in the extent of the periods of ovarian and testicular activity from year to year. However, the evidence indicates that in the Maryland muskrat spermatogenesis begins in the middle of December and ovulation in the middle of February and that seasonal gonadal activity terminates in both sexes during the latter part of October.

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"AUDIENCE ENEMIES"

IN SCIENCE for March 13, Dr. DuBois, of Cornell University Medical School, made a vigorous plea for improving the quality of presentation of papers at scientific meetings. He described the common "audience enemies" with such clarity that no possible defense could be offered for the speakers (their number is legion) who fail to recognize that "while effective presentation can never take the place of able investigation, it is the indispensable means of assuring full success to any investigation."[1] However, perhaps the one most common fault indulged in by inexperienced speakers because of stage fright and continued by a large number through sheer inertia is the custom implied by the title, but omitted from the body, of Dr. DuBois's discussion, "the *reading* of scientific papers."

It is bad enough for a teacher to read verbatim to students. They at least have some reason for listening. But for a scientist to address an audience of his peers, no doubt including many of his betters, by literal reading from typed pages, is gross discourtesy. The societies themselves may partly be to blame for the prevalence of this wide-spread "audience enemy." Programs of meetings all too commonly list "papers to be read" or "the following will read papers." Perhaps this time-"honored" custom should not be taken literally and that in such cases "read" really is intended to mean "present." Unfortunately, attendance at scientific meetings would indicate that many of our prominent workers take the literal interpretation and *read* their papers, word for word.

As a consequence, they address their papers and not the audience; they speak in language meant for publication, not oral presentation; they must look up and waste time when a slide appears and then rush back to the typed page after pointing to the screen, in so doing perhaps losing the place. It is virtually impossible for an investigator to make a vigorous oral presentation without looking at and deliberately focussing his attention upon his audience. Reading it is therefore ineffective and, worse, distinctly discourteous. Such a presentation automatically implies that any one could have read the manuscript, but that the investigator did so just to let the audience have a look at him. It also suggests that the speaker is willing to relate his results to his colleagues, but that they are not worth the effort required to prepare an effective oral presentation, utilizing very brief notes, if any.

Aside from papers "read by title only," we might well completely drop the word "read" from our scientific programs and practices.

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THE "audience enemies" Professor DuBois discusses in the March 13 issue of SCIENCE could be effectively controlled if our societies insisted on a rehearsal of their important programs. The officers would have an opportunity of verifying the speaker's ability to be heard and to keep within his scheduled time and might suggest elisions and improvements in arrangement. The radio broadcasters manage to do as much.

GILBERT DALLDORF

A SEVENTH "audience enemy" who should be added to the six described by Dr. E. F. DuBois in SCIENCE for March 13 is the person who reads aloud from his charts or lantern slides every word or number even

[1] Douglas Johnson, *Jour. Geomorphology*, I: 1, 64, 1938.

when "slow readers" can complete such information before the speaker is well started.

Audiences suffer, also, from speakers who discredit themselves by their slovenly pronunciation of basic scientific terms; *e.g.*, expuriment for experiment, chimistry for chemistry, bacterawlgy for bacteriology and vaurus for virus.

JEAN BROADHURST

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QUOTATIONS

"TO DO SOMETHING FOR THE WELFARE OF MANKIND"[1]

IN these dark days when the world is at war, when democracy is at bay, when no great acumen is required to perceive that a world revolution is in progress—a deep-seated battle between many varying ideologies with no clearly discernible final result—the place, the purposes, the value of the philanthropic foundation may easily come in question. Governments are expending astronomical sums and gigantic efforts for purposes of destruction; of what importance under such circumstances is the welfare of mankind? What values can the few millions of any foundation directed toward such an objective conserve for a future social fabric the pattern of which can be dimly seen, if at all, by the wisest of men?

Is it mere futility to expend money to increase knowledge; to improve the practice of medicine through education and research; to carry out experimental efforts for the improvement of methods for the advance of public health, in days when human life and health are necessarily subject to the needs of war; to devote funds to the improvement of hospital facilities and management; to grant fellowships to brilliant young men that they may be trained for the advance of scientific knowledge; even to attempt to relieve in some slight degree the starvation and misery brought about by the present world upheaval?

The Commonwealth Fund does not believe that such effort is futile. On the contrary, it is the belief of the fund that these undertakings are more important today than ever before. Knowledge and brains still have no substitute. No matter what the future may have in store, knowledge must be conserved and developed, brains must be trained and given opportunity. Not forever will force reign, not always will the organization of society—or its disorganization—preclude the benefits to mankind of scientific discovery, of knowledge, intelligence and understanding. Whatever philanthropic foundations can contribute to the forging of implements for a better day will not be lost. In many conversations during the past two years with able and intelligent leaders in various fields, the outstanding thought has in no instance been one of despair or futility, but rather courage and determination in the belief that now more than ever it is of first importance that the development of potentials for a better and happier world be continued. A few mad men may have seized upon the advances of science for their own destructive ends. But they will pass from the scene. Human living will be reorganized—progress may have been halted; it has not ceased.

Thus it is the duty and the privilege of foundations to "carry on" and to "carry through" to a brighter day. The thought can scarcely be better expressed than in the words of Mr. George W. Gray in the concluding sentences of his tribute to the work of Wickliffe Rose, "Education on an International Scale":

> . . . eclipse is not obliteration. The sun is blackly obscured but it will shine again. Hope feeds on the integrity of law both cosmic and moral. . . . No star is ever lost.

BARRY C. SMITH

[1] Introduction to the twenty-third annual report of the Commonwealth Fund.

SCIENTIFIC BOOKS

RADIATION THERAPY

The Biologic Fundamentals of Radiation Therapy. By FRIEDRICH ELLINGER. Preface by MAURICE LENZ. English translation by REUBEN GROSS. New York: Elsevier Publishing Company, Inc. $5.00.

THE biological action of radiation from x-ray and radium varies according to the conditions of application. With x-ray the primary effect is wholly due to the light of short wave-lengths emitted from the anticathode under the impact of the electron beam. These light rays then set free electrons when they are absorbed. With radium, while the alpha rays are usually removed by screening, beta rays are left unless the filter is heavy. Roentgen rays and gamma rays from radiation do not differ except in wave-length. Hence if the action of radiation is due to electrons no differences in biological effect should be expected from x-ray of different voltages or from radium, provided that the conditions of measurement are strictly comparable. This fact has almost never been considered by students of the problem, and the omission has led to the contradictory statements which still exist in the literature, many of which are quoted by the author. For example, as a proof of the different effects of

different voltages, the writer quotes from a table by Reissner and Wintz showing that the reddening of the skin giving the so-called erythema dose varies greatly with the filtration of the x-ray. Such an erythema may be produced by 450 r with unfiltered radiation while filtered radiation of higher voltages requires 700 r to give the same reddening of the skin. This, now known to be incorrect, is the type of much early work. The later quotations are from, for example, Stone (*Radiology*, 30: 88, 1938), who states that 25 per cent. more r measured in air can be given of roentgen ray at 1,000 KV than at 200 KV. Both statements are perfectly correct reports of experimental observations, but for instance taking Stone's figures, the back-scatter from the deeper tissues against the skin is 35 per cent. of the impinging dose with 200 KV x-ray, whereas it is only 3 per cent. with million volt x-ray. Hence the difference in effect is easily explainable, for with higher voltage the skin received about 25 per cent. less than with the lower. On the other hand, with Drosophila eggs suspended on thin gauze so that there is no back-scatter, Wood, Exner and Packard have shown that exactly the same doses are needed to kill these eggs with x-ray generated at 10 KV and with all intermediate voltages up to 1,000 KV. On the other hand, the practitioner of roentgen therapy is much more interested in Stone's report than in the results of the Drosophila eggs, for he is desirous of avoiding an erythema, and the higher the voltage, the less likely is an erythema to appear. Many of the older observations which Ellinger quotes were made with different exposure portals and show variations which are also entirely due to differences in scattering, not to some hypothetical differences in the effects of different wave-lengths of radiation. Ellinger quotes Sir Thomas Lewis to the effect that erythema of the skin produced by roentgen rays is due to the liberation of histamine-like bodies. But on the next page, he offers several criticisms of this theory which show that perhaps we still are unaware of the exact process. The effects observed certainly can not be correlated with damage to the cell ferments. Recent studies of the clinical course of erythemas have shown that there are great variations in the periodicity and types, and it is probable that the process is much more complicated than Lewis has suggested. It is interesting in this connection to recall an observation published years ago that the effect of extreme heat and cold gives rise to lesions of the tissues and of the vascular system nearly identical with those produced by x-ray and radium.

The writer turns after these general discussions of effects observed on the skin to the changes which are produced by the radiation of various organs. Present interest is for the moment centered upon the effects of radiation upon the male and female sex organs and the possible late damage to the offspring. It is very doubtful that the ordinary radiographic exposures used in studying the position of the fetus in the uterus before delivery have any notable effect, although heavy therapeutic radiation has occasionally been noted in human beings to induce extensive lesions in the child. Most of these examples have been drawn from patients who have been rayed for cure of fibromyomata of the uterus and are pregnant at the same time. It is unlikely that a viable child can be obtained with a fibromyoma of any size, but it is wise in general to make a preliminary Aschheim-Zondek test for pregnancy and to empty the uterus surgically before beginning x-ray treatment. A good many surgeons would recommend a hysterectomy under these circumstances in place of irradiation. From all these facts it is evident that temporary sterilization should not be done and if there is any reason for interference with possible future pregnancy, total sterilization should be accomplished either by x-ray or by surgery. Geneticists are agreed that it is doubtful that any notable effects will be discovered in the first generation of offspring after moderate radiation of the gonads, but point out that the second generation of animals shows radiation damage. They also are not in agreement that the moderate quantities of radiation used in diagnosis will cause serious lesions in the second generation; some doubt even the effects of large doses, and point out that inasmuch as most of such heavy doses to the genitals are given for carcinoma of the uterus or tumors of the testicle, the patient is sterilized anyway. It is well, therefore, to wait before making statements concerning irradiation damage until actual observations can be made upon human offspring. The first generation children of rayed individuals are now being married, and within the next twenty years it should be possible to get some useful statistics on this important question.

The author then proceeds to a survey of the effects of radiation upon the various types of malignant tumors, and discusses, in a general way, the application of the fundamental principles on which such treatment is based. Some of the opinions quoted concerning the influence of hormones upon radio-sensitivity are obviously without much scientific foundation, and the writer is a little uncritical in certain fields. For example, it is now certain that preoperative radiation of carcinoma of the breast is of no value, and post-operative radiation of the ovaries is of little therapeutic importance in restraining the growth of a cancer of other organs.

In a short chapter on the effects of corpuscular radiation from radioactive substances the writer quotes the studies of Zadek to the effect that the substances which he injected intravenously in the treatment of leukemias were dangerous to life and not very

effective. Ellinger properly refuses to commit himself on the therapeutic value of short-lived synthetic radioactive substances, expressing the opinion that while they are of immense importance in experimental physiology as tracers of various elements in the course of metabolism, their therapeutic value is still unproved. He also holds a very conservative attitude toward the use of neutrons until further information is available.

The subject of the effect of light, especially ultraviolet, upon the general health and in the therapy of disease is very thoroughly presented with interesting observations on photopigmentation drawn from the author's own investigations which tend to show that the presence of pigment alone is not necessarily protective. Photodynamic sensitization is reviewed, and the author makes the interesting statement that in xeroderma pigmentosa, usually assumed to be a light-sensitivity disease, the victim does not always show high light sensitivity and that the actual cause of the disease is still unknown.

In the fifth section the writer again reviews in considerable detail the theoretical notions in regard to the action of radiation which have already been discussed in the opening chapters. The modern literature on the subject is pretty well summarized, but he gets into difficulties in trying to reconcile some of the older work by Glocker and others with that of more recent observers, and the chief value of the discussion lies in showing that to many of these matters we do not as yet know the answer. He then turns to a study of the time factor in radiation and again finds it difficult to reconcile contradictory statements.

The book closes with an admirable bibliography of 1,100 numbers. Most of the references are correct. Only a few typographical errors are noted. There are also excellent author and subject indices. The volume offers a useful survey of a subject about which it is impossible to be dogmatic because of the huge gaps in our knowledge, not only of the underlying biological phenomena, but of the most suitable practical technics. Complete reversal in methods of treatment has taken place since radium and x-ray began to be used widely in the therapy of various diseases, especially cancer, and further advances depend largely upon the slow method of statistical investigation of large numbers of treated patients. Animal experiments have been of value chiefly as showing many of the fundamental laws which govern the action of radiation, but have not been of much use in deciding a host of practical questions which arise daily in the treatment of human cancer. More and more it is becoming evident as experience accumulates that there is no universally applicable technic for the treatment of the large number of diseases in which short wavelength radiation has in some hands proved of great value. The problem is one of practical therapy, not of biological theories.

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MODERN ALGEBRA

A Survey of Modern Algebra. By GARRETT BIRKHOFF and SAUNDERS MAC LANE. 450 pp. New York: Macmillan. 1941. $3.75.

THE rejuvenation of algebra by the systematic use of the postulational method and the ideas and point of view of abstract group theory has been one of the crowning achievements of twentieth century mathematics. Although many of the basic results stem back to Kronecker, Dedekind and Steinitz, the present-day subject is largely the creation of the great woman mathematician, Emmy Noether. "Modern Algebra," by one of her pupils, B. L. van der Waerden, will always remain the classical account of the subject as she conceived it.

Although two or three books on the new algebra have already appeared in English, the present volume appears to the reviewer to be the best all-round introduction to the subject, unique in its clarity, balance, generality and inclusiveness. The size and plan of the book preclude a comprehensive treatment of any one topic; in compensation, the authors are able to say something about nearly every important topic, and they usually succeed in saying the really important things. In addition the book is enlivened by striking applications of modern algebra to other branches of science and made eminently teachable by the inclusion of numerous excellent problems and exercises.

The power of the postulational method is emphasized from the onset by developing the properties of the integers, rationals, real and complex numbers along with the elements of ring theory and field theory from well-chosen postulates. There follow chapters on elementary group theory, vector spaces, linear groups, ideal theory, algebraic numbers, Galois theory and other topics. The geometrical treatment of matrices as linear operators over a vector space is a judicious innovation. The authors even find space for the fundamental ideas of lattice theory, a vigorously growing branch of algebra particularly cultivated by American mathematicians.

In conclusion, the book is emphatically recommended either as a text, an introduction to the literature or a bird's-eye view of one of the great branches of modern mathematics.

MORGAN WARD

Structure of Algebras. By A. A. ALBERT. 210 pp. New York: Colloquium Publications of the American Mathematical Society. 1939.

THIS book, written primarily for specialists in al-

gebra by one of the leading American experts, gives an authoritative account of linear associative algebras which have been the center of interest in algebra for over sixty years. The book is the first in English to utilize fully the new methods introduced by Emmy Noether and her pupils to refine and extend the theory. The preliminary knowledge necessary for its understanding may be found in the Survey reviewed above, or in the author's own text, "Modern Higher Algebra."

The book begins by giving in less than fifty pages all the classical structure theorems. The remaining three quarters of the book are devoted to the numerous new results obtained in the last fifteen years due in the main to Emmy Noether, Richard Brauer, Hasse and Albert himself. Particularly noteworthy are the chapters on the representation theory expounding the methods Albert developed in the theory of Riemann matrices and on the structure of rational division algebras where Albert has been able to avoid the complicated arithmetic of integral sets of an algebra. A final chapter, in which numerous unsolved problems are stated, and an excellent bibliography of the recent literature enhance the value of the book for the student.

The book is written with great clarity and precision and more than fulfils the author's stated purpose in the introduction: to provide "a text on the theory of linear associative algebras . . . (and) a source book for young algebraists." No mathematician at all interested in algebra can afford to miss it.

MORGAN WARD

SPECIAL ARTICLES

A NOTE ON THE HYGROSCOPIC PROPERTIES OF CLOTHING IN RELATION TO HUMAN HEAT LOSS

QUITE recently we have noted in studies of heat loss from clothed subjects that the thermal effect of moisture changes in clothing can be of large order in relation to human heat production. Such effects may produce confusing results in studies of heat loss under conditions of widely different relative humidity. In changing a clothed subject from a low to a high relative humidity at the same temperature, the effect appears as a plus error in the subject's heat balance. In short, the subject appears to produce more heat than can be accounted for by his metabolic rate. This process is the reverse of evaporation and is due to the absorption of moisture by the clothing with a resulting evolution of heat. In the reverse change, loss of moisture from clothing produces a greater cooling than can be accounted for by the temperature of the environment. Both efforts are transient, and disappear under conditions of equilibrium.

Loss or gain in textile weights due to hygroscopic properties has received extensive study from the standpoint of the industries concerned. The relative humidity of the ambient air has been considered as the critical factor involved and standard regain tables are available which give the weight of moisture picked up (or regained) by 100 parts of a given dry material at equilibrium in an atmosphere of a given relative humidity. These tables show that between 30° and 100° F. air temperature has a minor effect on the ultimate state of equilibrium. In industry attention is given to moisture regain because of its technical importance in spinning and its bearing on true weight of yarn sold or received.

This factor has importance at present because of the interest of physiologists, biophysicists and engineers in developing highly efficient garments for human protection under extraordinary conditions of climatic exposure. In attempting to deal with this problem in our own laboratory we have found no satisfactory references reporting the time curves of these adjustments in textile moisture content. This is the important factor, since it is obvious that the evolution of 100 calories of heat in a garment over a period of 48 hours is of little practical consequence. On the other hand, if a considerable fraction of this heat is released, under certain conditions, over a period of one, two or three hours, the practical effect may be considerable.

For the benefit of others who are concerned with this field, we are reproducing data which will be of assistance in roughly estimating the order of this effect in time. The results apply to a man's woollen garment weighing 1.86 kilos when dry at 70° F.

A temperature and humidity controlled room was available for this study. A Sauter balance of 20 kilo capacity and sensitive to 50 milligrams was used. The garment was originally allowed to come to equilibrium at 70° F and 25 per cent. relative humidity. It was then weighed and packed in an air-tight metal container, while the temperature and relative humidity were being adjusted to a new level. The garment was then unpacked and hung on the balance. Weight gain or loss was recorded continuously at set intervals until full equilibrium was reached (Curve 1). This procedure was repeated, using a new temperature and relative humidity setting for the last half of the operation. The garment was tested over a temperature range from 45° to 90° F. At each temperature a high and low relative humidity was established (77 per cent. and 30 per cent. approximately). The re-

sults of nineteen different exposures are shown in Fig. 1. The graph represents gains and losses of weight in the suit for the first six hours. Final equi-

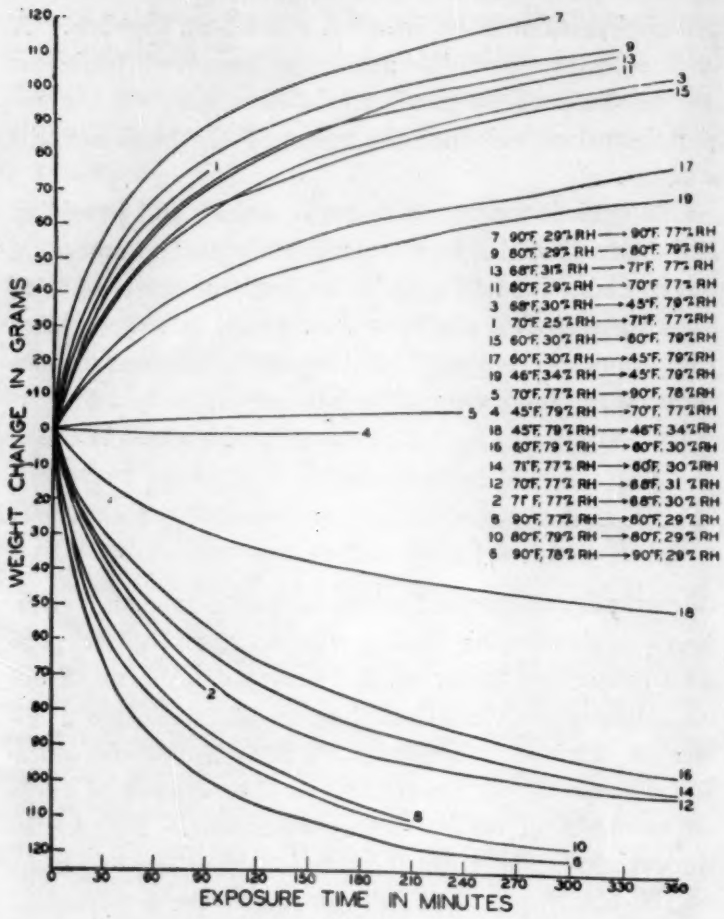

FIG. 1

librium was reached in most cases within twenty-four hours. The legend referring to each curve indicates the condition at which the suit was in hygroscopic equilibrium when exposure started, and the exposure condition which resulted in a given weight gain curve. For example, the legend for Curve No. 7 reads 90° F, 28 per cent. R.H. → 90° F, 77 per cent. R.H. This means that when the suit was in equilibrium at 90° F and 28 per cent. relative humidity and was then exposed to a condition of 90° F and 77 per cent. relative humidity, it gained weight as described by this time curve.

The significant effect of garment moisture gain or loss on skin temperature and heat balance may be illustrated from the magnitude of the weight changes in the first hour of exposure. For example, in Curve No. 7 again: In the first hour the garment picked up 76 grams of moisture which has a heat gain equivalent of about 44 calories.[1] This value is 50 to 60 per cent. of the resting hourly heat production of an adult man. If one started with a heavy garment of 3 to 4 kilos dry at moderate temperatures, the total heat evolution in the first 2 or 3 hours would obviously be at least equal to the physiological heat production at rest. All curves indicate that more than half the total change in weight takes place in the first two hours of exposure. Another conclusion to be drawn from the figure is that relative humidity influences the weight change far more than temperature, although the effect of 10° rises in temperature is observable for comparable relative humidities. Finally, it may be of some interest to note a hysteresis effect. At a fixed temperature, in varying relative humidity from a given low to a given high value and back to the original low again, the garment gained more moisture before reaching equilibrium at the high humidity than it lost in returning to equilibrium at the original low humidity.

A thorough knowledge of the hygroscopic properties of different materials as well as the thermodynamic implications inherent in the body-clothing system is of considerable importance in designing protective garments for optimum comfort under extreme conditions.

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TREATMENT OF RENAL OSTEODYSTROPHY WITH DIHYDROTACHYSTEROL (A.T.10) AND IRON

RENAL osteodystrophy is a generic name for osseous disorders simulating rickets, osteomalacia or osteitis fibrosa cystica, but originating from chronic renal insufficiency. The most important metabolic defect is poor calcium absorption due to large phosphorus excretion by the bowel as a result of renal insufficiency. Yet vitamin D, specific in promoting calcium absorption in rickets and osteomalacia, is singularly ineffective in renal osteodystrophy. This is true in a series of 5 cases in which detailed metabolic studies were made in this clinic. Vitamin D in ordinary therapeutic doses for prolonged periods orally or intramuscularly or in single massive dose by mouth fails to elicit any significant clinical or metabolic response.

This led us to the use of dihydrotachysterol (A.T.10), an irradiation product of ergosterol, first introduced by Holtz[1] in the treatment of hypoparathyroid tetany. Our experience with A.T.10 in cases of osteomalacia[2] indicates that this compound promotes calcium and phosphorus absorption by the intestine and deposition in the bones, contrary to the earlier view[3] that A.T.10 was not anti-rachitic.

[1] The calorie equivalent of a 10-gram change in weight is about 5.8 calories.

[1] F. Holtz, H. Gissel and E. Rossmann, *Deutsche Ztschr. f. Chir.*, 242: 521, 1934.

[2] H. I. Chu, S. H. Liu, H. C. Hsu and H. C. Chao, "Calcium and Phosphorus Metabolism in Osteomalacia." XI. A Comparison of the Effects of A.T.10 (Dihydrotachysterol) and Vitamin D. To be published.

[3] F. Albright, *et al.*, *Jour. Clin. Invest.*, 17: 317, 1938; 18: 165, 1939.

view of the favorable effects on osteomalacia, two of our patients with renal osteodystrophy received by mouth A.T.10 in 3 cc daily doses for 5 four-day metabolic periods while on a high calcium and moderate phosphorus intake. In both cases there was an immediate and progressive decrease of fecal calcium. While calcium appeared in significant amounts in the urine in one case, it remained absent in the other. The net retention of calcium at the height of A.T.10 action during the last period of its administration or the following period amounted to 50 per cent. of the intake. This was followed by a corresponding phosphorus gain due to a diminution of phosphorus elimination both in the stool and in the urine. The serum calcium, low initially in both cases, was raised to normal; and the inorganic phosphorus, high to start with, was reduced to normal during the A.T.10 therapy. Thus in remedying the basic metabolic defect underlying the bone disease in renal osteodystrophy, dihydrotachysterol appears to be highly efficacious, similar to vitamin D in rickets and osteomalacia. However, the effect of A.T.10 lasts for 7 or 8 four-day periods after the therapy is discontinued, in contrast to the long-sustained aftereffect of vitamin D in rickets and osteomalacia. Therefore, to secure substantial remineralization of the skeleton in renal osteodystrophy it would be necessary to administer A.T.10 for a prolonged period of time.

Another mode of therapy which we believe to be of interest in renal osteodystrophy is the oral administration of iron salts. It is well known in elementary chemistry that iron combines with phosphate to form insoluble ferric phosphate. That similar reaction takes place in the intestine is indicated by the experimental work[4] showing that iron added to a non-rachitogenic diet of rats produces rickets. Thus iron in large doses is contraindicated in rickets and osteomalacia. However, in renal osteodystrophy with hyperphosphatemia and high concentration of phosphate in the intestine interfering with the assimilation of calcium, the phosphate-precipitating action of iron may be utilized to advantage. Accordingly, the two patients wtih renal osteodystrophy referred to above were given ferric ammonium citrate 6 gm daily for from 5 to 14 metabolic periods. The most consistent changes were a decline of the serum inorganic phosphorus and an ascending tendency of the serum calcium. The phosphorus balance showed a decline due to an increase of stool excretion of phosphorus. The fecal elimination of calcium was usually diminished, giving rise to favorable calcium balance. This increase of calcium retention is most probably the result of the calcium-sparing action of iron in combining with phosphorus in the intestine. Thus from the standpoint of combating phosphate retention and promoting calcium gain in renal osteodystrophy, iron therapy proves effective.

In view of the present unsatisfactory state of affairs in the therapy of renal osteodystrophy, dihydrotachysterol (A.T.10) and iron seem to be rational and useful items in the treatment of such condition. As far as we are aware, the use of A.T.10 or iron in osseous disorder due to renal insufficiency has not been recorded in the literature. This is a preliminary report, and the detailed data will be published elsewhere.[5]

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[4] J. F. Brock and L. K. Diamond, *Jour. Pediat.*, 4: 442, 1934.

[5] S. H. Liu and H. I. Chu, "Renal Osteodystrophy: Studies of Calcium and Phosphorus Metabolism with Special Reference to Pathogenesis and Effects of Dihydrotachysterol (A.T.10) and Iron." To be published.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

CONCERNING THE NATURE OF TYPE C BOTULINUS TOXIN FRACTIONS

THE first portions of condensate obtained by use of the standard lyophil apparatus in the dehydration of type C botulinus toxin consist of a high concentration of the thermo-stable fraction of this toxin. Recognition of this fraction in botulinus toxin was announced by Bronfenbrenner and Schlesinger in SCIENCE in 1921, though they gave no method of obtaining it in pure form in quantities sufficient for our study purposes.

This fraction, which for convenience may be designated as A, consists of ammonia salts. It is thermo-stable, and may be obtained in high concentration in almost pure aqueous solution by the method named. No antigenic property has been demonstrated for this fraction and it, therefore, has no specific antibody. Neutralization by type C antitoxin does not occur. Fraction A is a neuro-toxin which acts without delay. Sub-lethal intraperitoneal doses in mice result in nervous irritability for about 30 seconds, followed by what appears to be a complete anesthesia for four to six hours and eventual complete recovery. Thirty intraperitoneal, 18 gram mouse, mld's, administered orally to a three-pound mallard duck, result in a typi-

cal case of botulism. The onset in the duck is rapid with paralysis of the third eyelid and complete paralysis within one hour. Complete recovery may occur as early as the 24th hour, though 48 hours is the more common period.

Fraction A is volatile and escapes from an open vessel on prolonged boiling. It is very stable at room temperature and resistant to bacterial action as opposed to the thermo-labile fraction. Non-sterile, corked samples have been held for a ten-month period at room temperature without loss of toxicity.

It is unlikely that the A fraction ever exists in the free state in nature. Removal of this fraction from the toxin mixture as evolved by bacterial growth results in a remaining fraction which is no longer toxic by oral administration, though it is still toxic by injection. Restoration of the A toxin fraction regularly results in a return to toxicity by the oral administration of the mixture.

Fraction A is destroyed by strong alkali. This fact, coupled with the above findings, may account for the occasional collection of field samples, in semi-arid regions, which are toxic by injection in test animals but which are comparatively *non-toxic* by oral administration in normal doses. Complete separation of the two toxin fractions in nature has not been demonstrated. Reduction of fraction B to powder dryness by the lyophil process results in only partial loss of toxicity by the inoculation route.

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A DARKENING TECHNIQUE FOR INDUCING VIRUS SYMPTOMS IN MATURE AS WELL AS IN GROWING LEAVES

A RECENT article[1] on rapid transmission techniques for stone-fruit viruses was concerned with such devices as pruning, defoliation and girdling of growing plants for the purpose of shortening the incubation period. Incidentally, these techniques also offer promise for producing intensification of disease symptoms and for concentrating viruses in local areas.

Still more recently it has been discovered that the simple device of excluding light from the leaves into which one wishes to move the virus functions in a similar manner to the above but has the additional merit of inducing symptoms also on shoots and leaves that are not growing. To date only the virus of the Yellow-Red or X disease of peach has been tested, but it seems probable that the effects of shading will be generally applicable to other plant viruses.

Darkening the upper half of young rapidly growing peach seedlings for 2 weeks induced disease symptoms, sometimes within 4 weeks from the time the shades were installed. Similarly, darkening one of the branches on older seedlings which had completed their first season's growth induced symptoms within 6 weeks after the shades were installed. Although in these particular experiments the symptoms were not evident before 4 to 6 weeks after darkening, the shades need not be left on more than about 2 weeks and possibly the time of shading can be still further shortened. The growing seedlings were about 20 inches tall, branchless and each received a diseased bud midway on the stem. The older non-growing seedlings had either 2 or 3 branches and each received a diseased bud (sometimes with difficulty because of the cambium condition) near the base of the branches. Thus it was possible to darken either budded or unbudded branches. The shades, consisting of lightproof paper envelopes, had proper provision for ventilation and were held in place by clips attached to a stake.

The movement of the virus is apparently associated with the major movement of carbohydrate as pointed out by Bennett[2] for curly top virus movement in sugar beet and tobacco. Shading a portion of a plant stops photosynthesis in that part and favors the transport of carbohydrate into the shaded part, and if the entering food passes through a part of the stem containing the virus the latter apparently is carried along with the food. By placing the diseased bud somewhere between the shaded region and the food source, which in this case was unshaded leaves carrying on photosynthesis, it has been demonstrated that the virus was carried into the shaded leaves which were receiving food. Therefore, the fact that temporary darkening will induce entrance of the virus and the development of disease symptoms in non-growing as well as in growing tissues affords another important transmission technique to expedite investigations on plant viruses. Since darkening does not involve severe treatment of the plants nor necessitate new plant growth for symptom expression it should prove of value in many situations where pruning, defoliation and girdling can not satisfactorily be used or where it is difficult to induce the formation of new shoots.

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[1] E. M. Hildebrand, SCIENCE, 95: 52, 1942.

[2] C. W. Bennett, *Jour. Agr. Res.*, 54: 479–502, 1937.

BOOKS RECEIVED

ALLEN, HUGH. *The Story of the Airship (Non-Rigid).* Illustrated. Pp. ix + 74. The Goodyear Tire and Rubber Company. $1.00.

ARLITT, ADA HART. *Family Relationships.* Pp. x + 277. McGraw-Hill Home Economics Series. $2.50.

WEBSTER, LESLIE T. *Rabies.* Pp. vi + 168. Illustrated. The Macmillan Company. $1.75.

NEW WILEY BOOKS

Ready Spring 1942

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806 pages; 6 by 9; $6.00

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SCIENCE NEWS

Science Service, Washington, D. C.

PAPERS READ BEFORE THE BOSTON MEETING OF THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

BALDNESS, cataracts of the eyes, poor teeth and inability to father offspring all may result from lack of one single food chemical in the diet, tryptophane. Dr. Wilhelm Buschke, Dr. Anthony A. Albanese and Dr. Richard H. Follis, Jr., of the Johns Hopkins University, announced the results of their work on March 31 at the opening session of the Federation of American Societies for Experimental Biology. Tryptophane, the food chemical lack of which can bring on the four symptoms, is one of the ten essential amino acids which are building blocks of proteins. The proteins of cereals or grains in general contain considerably less tryptophane than proteins in animal foods such as meat, fish, poultry, eggs and milk. The discovery indicates the danger of relying entirely on cereals as source of protein, as might be done in a post-war world faced with grave shortages of other kinds of foods. The danger of one-sided diets containing inadequate sources of amino acids has long been suspected. Studies by other investigators have shown that laboratory rats can not manufacture the ten essential amino acids in sufficient amounts in their bodies to supply their needs for normal growth. It was assumed that man also required these protein building blocks in his food. These researches, however, show for the first time the full extent of the damage resulting from lack of one of these acids, tryptophane, and gives also for the first time concrete evidence that humans as well as laboratory rats require this amino acid.

Human need for another amino acid, arginine, suspected of being a paternity chemical, has previously been reported by Dr. Albanese and associates. The baldness, cataracts, malformation of tooth enamel and wasting of the male sex glands resulting from lack of tryptophane in the diet were demonstrated in paired feeding experiments with rats. But human volunteers who ate a diet lacking this chemical showed the effects of the deprivation through chemical tests. If they had continued as long on the diet as the rats did, they would probably also have grown bald. The tooth defects and the cataracts occurred only in young, growing rats on the tryptophane-lacking diet. The baldness and sex gland destruction occurred in both young and old rats. The baldness and the cataracts could be cured by adding tryptophane to the diet. Some of the changes resulting from lack of tryptophane also occur in vitamin A starvation. This may mean that without plenty of tryptophane, the body can not use vitamin A even if it is present in the diet.

Demerol, a new synthetic pain-killing drug that comes closest of any so far developed to being the long-sought safe substitute for the poppy's morphine, was described. Favorable results from its first U. S. trials on nearly 1,000 patients and laboratory animals were reported by Dr. David R. Climenko, of the Research Laboratory of the Winthrop Chemical Co.; Dr. Robert C. Batterman, New York University College of Medicine, and Dr. H. L. Andrews and Dr. C. K. Himmelsbach, of the U. S. Public Health Service's hospital for narcotic drug addicts at Lexington, Ky. Summing up the observations of these men, it appears that relief of pain requires larger doses of Demerol than of morphine. Making up for this is the greater safety of Demerol, which allows physicians to give much larger doses of it than of morphine. The pain-relieving effect starts within 15 or 20 minutes and lasts for as long as six hours. It is most dramatic in patients suffering from the excruciating pain caused by kidney stones and gallstones. Demerol, like morphine, is habit-forming but unlike morphine, it has almost no addiction property, that is, it does not cause physical craving for the drug to the extent that morphine does. Demerol was first developed in Germany but is now being made in the United States. It is not yet available except to research institutions, pending approval by the U. S. Food and Drug Administration of an application for its more general release. Even if it becomes available commercially, it will probably not be sold without a physician's prescription.

Heavy drinkers of whisky and other alcoholic beverages probably do not require extra amounts of vitamin B_1 to protect their nerves and keep them healthy. Experiments casting "considerable doubt" on the current theory that alcohol increases the body's need for this vitamin were reported by Dr. J. V. Lowry, Dr. W. H. Sebrell, Dr. F. S. Daft and Dr. L. L. Ashburn, of the U. S. National Institute of Health. In these experiments rats kept on the water wagon without exception developed the severe nervous disorder believed due to B_1 deficiency in alcoholism before their litter mates that were getting alcohol or whisky. The nervous disorder could be prevented and cured by the vitamin, regardless of whether the rats drank alcohol, water or whisky. These experiments give the first indication that alcohol does not require vitamin B_1 to help burn it in the body. They suggest that a person who sticks to a good diet could probably drink a quart of whisky daily without needing extra vitamin B_1 to burn the alcohol. If, however, he neglects his diet, as alcoholics probably do, and fails to eat enough foods containing vitamin B_1, he would develop the nervous disorder. The whisky or alcohol could be blamed for causing the change in diet but not for causing the sickness by depleting the body of the vitamin.

Germs may be at the root of the gray hair problem. This possibility appears in a report made by Dr. Gustav J. Martin, of the Warner Institute for Therapeutic Research, New York City. Dr. Martin is one of a group who last fall reported that lack of a vitamin-like chemical, para aminobenzoic acid, was the cause of gray hair and that doses of this chemical would remedy the condition. Dr. Martin's studies were on rats, while others applied the findings, apparently successfully, to humans with gray hair. Now Dr. Martin reports, after

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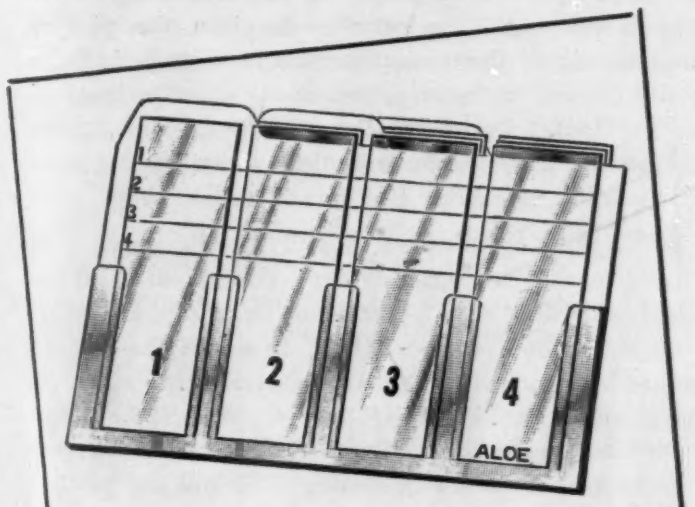

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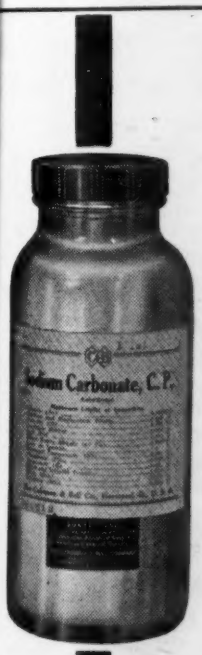

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further experiments with rats, that it is not PAB (para aminobenzoic acid) alone, but the ratio of this chemical to another vitamin chemical, pantothenic acid, that is the important factor deciding whether or not rats, and possibly humans, will turn gray. A ratio favoring PAB results in graying. The germs come into the picture because certain of these microbes, harmless ones that are normally present in the intestinal tract, are stimulated to grow by PAB. Probably, Dr. Martin explains, these germs destroy pantothenic acid, thus upsetting the ratio of this vitamin to PAB.

"X," signifying unknown, is still the only name that can be given to the anti-gray hair vitamin or food ingredient, according to a report from Dr. F. Peirce Dann, Dr. Ruth C. Moore and Dr. D. V. Frost, of the Abbott Laboratories, North Chicago, Ill. PAB had no effect on graying alone and slight, if any, supplementary effect with calcium pantothenate, in the case of rats. Giving all the known B vitamins including PAB did not prevent graying. But brewers' yeast and whole liver powder each prevented graying. So an unknown is again proposed as the anti-gray hair chemical in food.

PAB, demoted as anti-gray hair chemical, may turn out to be a vitamin promoting youthfulness and romance in a slightly different way, it appears from other experiments reported by Dr. G. J. Martin, Dr. S. Ansbacher and Dr. W. A. Wisansky, of the research laboratory of the American Home Products Corporation, at Richmond Hill, N. Y. Daily doses, in many cases, "seemed to stimulate appetite, to increase libido, and to improve certain asthmatic conditions." They believe this chemical may act to protect or spare certain of the gland chemicals of the body.

A link between the thyroid gland in the neck and acne, the pimply skin condition that is the bugbear of the late teens and early twenties, was announced by Dr. Broda Barnes, of the University of Denver. Treatment with thyroid gland extract is bringing improvement in severe cases of acne that were not helped by any other kind of treatment. It is too soon to be sure of the results, but they suggest that an underactive thyroid gland may be a factor in causing acne. Basal metabolism tests, which indicate whether or not the thyroid gland is producing enough of its hormone, were run on 85 college men and women with acne. In general, the worse the acne, the lower was the metabolic rate, indicating lack of thyroid hormone.

Brain workers apparently would be able to do more and perhaps better work, or at least could do their regular work with less fatigue, if they increased their daily ration of B vitamins above the amount required by the average healthy person. Those who perform physical work, however, need not expect any increase in muscular strength or endurance or any lessening of muscular fatigue through taking extra amounts of B vitamins. These are the conclusions of studies reported by Dr. Ernst Simonson, Dr. Albert Baer and Dr. Norbert Enzer, of Milwaukee. A large surplus of the vitamin B complex was given to twelve healthy persons and compared them with eleven people on an ordinary diet. The extra vitamin ration had no detectable effect on any type of muscular activity, neither endurance, recovery, speed, force n fatigue, but it did prevent fatigue of the central nerv system, which includes the brain.

Somewhat disconcerting to the chemists at the meeti was the discovery announced by Dr. E. C. Kendall, of t Mayo Clinic. In their efforts to extract hormones fro the adrenal gland cortex in a state of pristine purity, t chemists, it appears, have defeated the physician's go of extracts that are effective in treating sick people. T activity of the gland extract itself is ten to twenty tim that of the hormones that have been obtained in pu crystalline form. In future, he advises, chemists mu find a way not only to extract the gland material com pletely but also to safeguard the enhanced activity of t hormones as they occur in the natural state in the bod

Reports of a new sulfa drug, a possible diabetes re edy from a Puerto Rican plant, and the hazard of mag nesium in certain industries and war wounds was report in the closing sessions. The new sulfa drug is sulfapyr zine. It was introduced by Dr. George W. Raiziss, D M. Severac and Dr. J. C. Moetsch, of the University Pennsylvania and the Abbott Laboratories. It has t advantage of being rapidly absorbed when taken b mouth, and hence of quick action, tests on mice showe In these animals it proved to be effective against tw types of pneumonia, a streptococcus infection and staphylococcus infection.

The possibility of a plant chemical becoming a di betes remedy appeared in the report of Dr. Gilber Rivera, of the Tropical School of Medicine, University Puerto Rico. The plant is the balsam pear or "a pumpkin," known to Puerto Ricans as Planta Cundeam and to American botanists as Mormordica Charanti Chinese gardeners grow it around American cities und the name of la-kwa, and Chinese cooks have used it i stews for sick people. The Puerto Rican natives, ho ever, actually used it to treat diabetes, and Dr. Rivera scientific studies show that it does lower the blood sug of both animals and human diabetics. Insulin, of cours is the standard remedy for diabetes, but both before an since its discovery, search for other diabetes remedies ha been made. Dr. Rivera warns against use of the pla to treat human diabetics until further studies of its to icity and possible value have been made.

Wounds from bomb fragments or aircraft fragment that contain magnesium may have special complication as a result of the body's reaction to magnesium splinter according to Dr. Carl W. Walter and Dr. Reuben L Schulz, of Harvard Medical School. When this metal o its alloys get into tissues under the skin, it causes a injury scientifically termed a pneuma-granuloma, whic might be roughly translated as a gas cancer or gas tumo The metal becomes jacketed with fibrous tissue surrounde by spaces filled with gas under pressure. The injury e pands slowly as gas accumulates, compressing adjace tissues, just as a cancer or tumor increases in size an compresses neighboring tissues and organs. This ga tumor is also a hazard to workers in industries whe magnesium may get into accidental wounds. In the ca of both industrial and war wounds, the magnesium shou

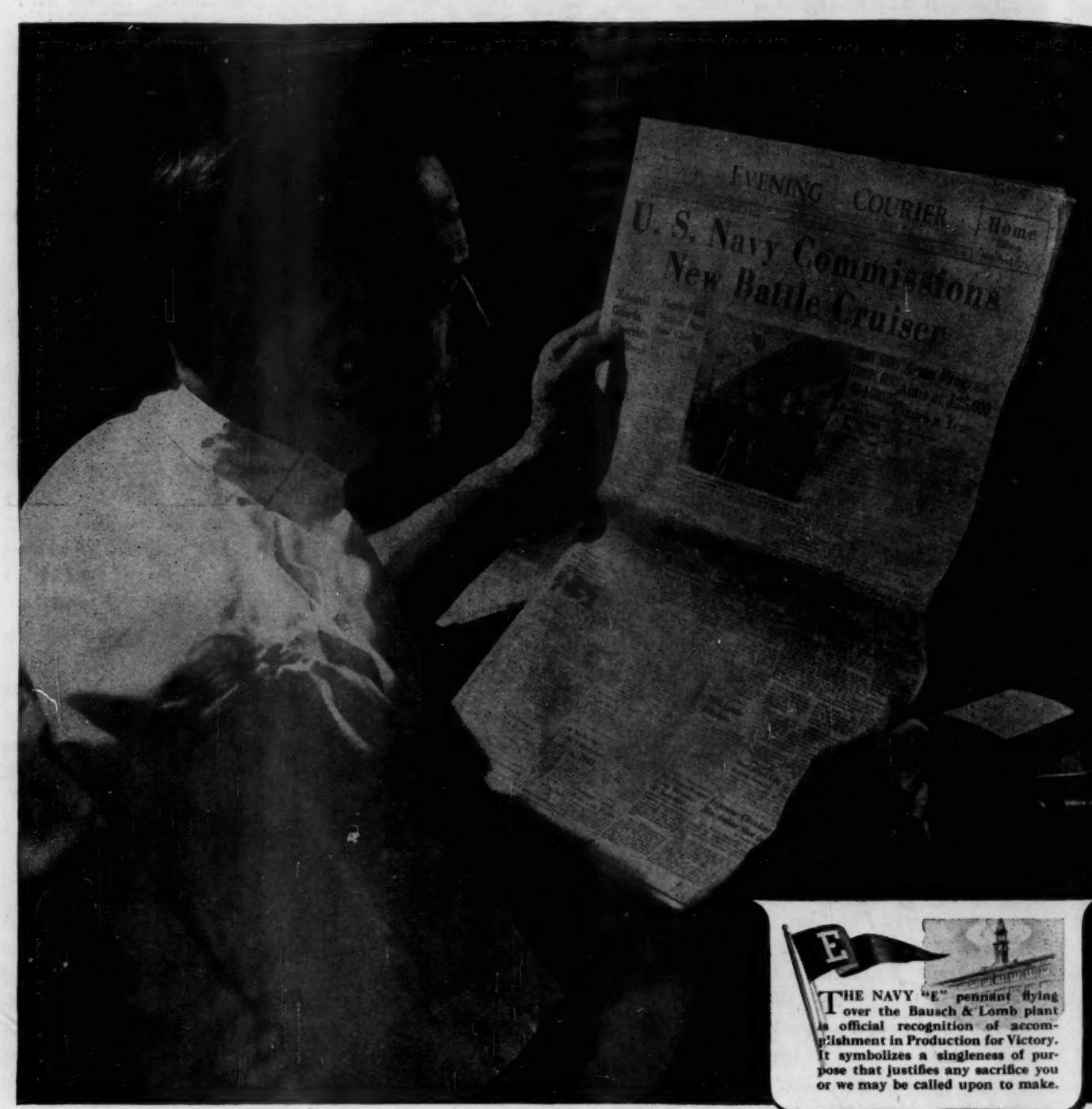
be removed immediately to avoid dangerous encroachment of the gas tumor on vital tissues.

Safer blood transfusions may result from studies reported by Dr. N. A. Masor, Dr. Harry Greengard, Dr. W. H. Voegtlin, Dr. J. P. Sandblom and Dr. A. C. Ivy, of Northwestern University Medical School. A relation between the kind of foods eaten by the donor and recipient and harmful reactions to blood transfusions was discovered in studies on dogs. Harmful reactions occurred most frequently when the recipient had been fasting, as many patients receiving transfusions must do because of their serious condition, and the blood donor had been fed before the transfusion a protein or carbohydrate-protein meal, as for example, meat, or meat and potatoes or meat and bread. Harmful reactions in a fasting recipient occurred less frequently when the donor had been fed a meal of starches and sugars alone, or had also been fasted before giving blood. No harmful reactions occurred when both donor and recipient were fed before the transfusion or when the recipient was fasting and the donor was fed fat.

Uncle Sam may be missing a few hardy workers by putting the upper limit of the draft at 64 years, it appears from a study reported by Dr. F. A. Hellebrandt and Dr. Percy M. Dawson, of the University of Wisconsin Medical School. Dr. Dawson himself is one 68 years old who has lost surprisingly little ability to do hard muscular work and to recover therefrom. This is true even though, as he points out, maximum strength and endurance are reached at about thirty years of age and the ability to carry on sustained work is thought to dwindle during the later years of mature life. He and Dr. Hellebrandt compared his present ability to pedal a bicycle with his ability 17 years ago as a way of studying the effect of aging on fitness for muscular work. The bicycling in such experiments is done to the limit of effort and the amount of work done is measured. Dr. Dawson took part in such experiments in 1914, 1926, 1927 and 1929. His present performance is about 72 per cent. of his 1914 performance and about 80 per cent. of that at the age of fifty-three years. His optimum speed of pedalling had dropped 12 per cent. The maximum heart rate, systolic blood pressure and pulse pressure attained during exercise fell short of the peak values of 1914. Recovery from the acute effects of the effort was prompt and uneventful. Transitory abnormalities in heart rhythm occurred once. A mild post-exercise negative phase in blood pressure followed the severest ride. There was less resilience than earlier, extending the number of rest days required between rides. Staying power improved about 150 per cent. during the brief period of training.

Prediction that both man and his domestic animals are going to suffer from the present trend toward non-fatty diets was made by Dr. G. O. Burr, of the University of Minnesota. The latest discoveries show that fats do more than supply energy. They contain substances, the fatty acids, needed for the health of many vital parts of the body such as the kidneys, reproductive organs and skin. These fatty acids serve as essential building stones of the body. One of them, linoleic acid, which gets its name from linseed oil, is especially important to the health of the skin. Physicians have already applied this discovery with success in treatment of some skin disorders. Babies with intractable eczema and grown-ups who have "never had a clear skin since they could remember" have been cured of their skin trouble by doses of linseed oil or by diets that supply plenty of this fatty acid through butter, lard and salad oils. This treatment will not cure every case of skin trouble because not all cases are necessarily due to lack of linoleic acid in the diet. He thinks, however, that the average diet contains too much starchy and sweet food and not enough fat of the kind that supplies linoleic acid. The skin effects of lack of this acid, he said, become especially noticeable when humidity is low, as in heated houses, or when some of the vitamin B complex is also missing or scanty in the diet. Common diets contain only about 5 per cent. of their calories in fat. This is much too low.

Excessive acidity of the nerves may be responsible for a host of serious ailments, including the dangerous condition that overcomes high-altitude flyers and mountain climbers, was pointed out by Dr. Robert Gesell, of the University of Michigan. The acid nerve condition which may be responsible for pilot failure in high-altitude flying without oxygen can not be counteracted by the soda bicarbonate or other alkaline powders which the layman takes for his so-called acid stomach. Excessive alkalinity of the nerves may cause just as much trouble as excessive acidity, but it can not be corrected by taking lemon juice. Neither acids nor alkalies that people could take into their stomachs would change the acid or alkaline state of the nerves. To change nerve acidity requires injections directly into the veins of the very powerful alkalizing or acidifying chemicals. The degree of acidity or alkalinity of nerves that makes the difference between health and serious illness is actually rather small. But the shift from just the proper balance to excessive acidity or alkalinity of the nerves may influence all body processes, including breathing, heart action and digestion, Dr. Gesell believes. When the nerves are made too acid, he discovered, they discharge excessive quantities of the chemical, acetylcholine. It is this chemical, many scientists believe, which causes a muscle to move in response to a nerve impulse. Sometimes muscles go on moving along after the nerve impulse has ceased. A familiar example is the trembling that follows prolonged or excessive physical exertion. Epileptic fits are attributed by some scientists to the same mechanism, which is called the after discharge. The theory is that the nerves continue to release acetylcholine which, as it piles up in the muscles, keeps them contracting. Excess acid, Dr. Gesell's experiments show, is responsible for this condition. Why the nerves become too acid or too alkaline is not entirely known. Too little oxygen and too much carbon dioxide apparently can cause acidity, and the reverse can cause alkalinity. Increasing nerve alkalinity, Dr. Gesell found, facilitates the destruction of the nerve chemical, acetylcholine. This might lead to paralysis. A kind of convulsion accompanied by muscle cramps, called tetany, and coma or unconsciousness, are other conditions which may be explained on the basis of acid or alkaline nerves, Dr. Gesell believes. Working with him on the experiments were Professor Charles R. Brassfield, Elwood T. Hansen and Arnold Mason, also of the University of Michigan.



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